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THE

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Physiology of the Heart of the Sea-Turtle.

By T. Wesley Mills.

(*Concluded.*)

VII. *Anatomy of the Sympathetic System of Nerves in the Sea-Turtle.*

The detailed description which I have given of this system for the Terrapin,[1] and which, judging from the account of Gaskell[2] and Gadow, applies largely also to the land tortoise, may, with slight modification, be considered as expressing the relations of the sympathetic, vagus, &c., for one species of sea-turtle, viz., *Chelona mydas*. The resemblance in this respect of this one species to the Terrapin, and its wide divergence from the other species of sea-turtle examined by me, have been very surprising.

In *C mydas* there is the same difference in the size of the sympathetic and the vagus; the same tendency to union for part of their course; the marked distinctness of the ganglion

[1] *Journal of Physiology*, vol. vi., pp. 264-266. [2] *Op. cit.*

on the main sympathetic stem, &c., seen in the Terrapin; and the figure given in Plate (fig. 4) is intended to show in a general way the condition of things present in the Terrapin and *C. mydas.*

But as no satisfactory description for physiological purposes has been published for the marine turtles, I shall describe what I have found on the examination of a large number of cases. So much difference has been found in individuals, and the general plan is so disguised, that it was only after considerable examination and comparison that the typical structure could be defined.

In *C. caretta* and *C. imbricata*, the great size of the sympathetic in the neck, almost equal to that of the vagus, is in striking contrast with the condition in *C. mydas*, which has the sympathetic scarcely larger than in the Terrapin; also in the two first-mentioned species the vagus and sympathetic run widely apart throughout their whole course; in *C. mydas*, as in the Terrapin, they sometimes fuse, but not inseparably.

As regards the condition existing at or near the entrance of these nerves into the skull, much difference in details has been found.

In the Loggerhead and Hawksbill there is always more or less fusion above at this point; but in some cases there does not seem to be any genuine blending, for the nerves (vagus, glosso-pharyngeal, and sympathetic) are separable by a "seeker." There is a slight cord-like swelling in the sympathetic, and beyond this, two separate divisions enter the skull together, and do not seem to have any close connection with the sympathetic.

In these two species I have never found above any such well-defined fusion as exists in the Terrapin and *C. mydas.*

But by far the most remarkable condition found in *C. caretta* and *C. imbricata* is that seen in the third ganglion of the sympathetic stem. It was only after finding a case like that shown in fig. 3 that it became clear that in this ganglion the third and fourth ganglia of the stem were fused together; but when *C. mydas* was examined, it was seen that fusion was not, in that species, the rule, but the exception, as in the Terrapin.

What is depicted in Plate (fig. 1) as *ganglion cardiacum basale* must be regarded as the results of the fusion of the inferior cervical ganglion and the first thoracic (G. stellatum).

All of the ganglia, except this one, are very ill-defined cordiform swellings, scarcely recognizable but for the branches they give off.

The accelerating branch from the middle cervical ganglion is very much more constant and very much better defined even in *C. mydas* than in the Terrapin. The branch has not in my specimens ever been paired.

The vagus ganglion on its main stem is slightly better marked than the one corresponding to it on the sympathetic. It gives off a very great number of strong branches to parts below (fig. 2.)-

The brachial plexus in the sea-turtle is exceedingly strong, and forms an interlacement of great complexity. The branches proceed from the fifth or sixth to the ninth metamere.

From the ganglion cardiacum basale, several branches proceed upwards to the different parts of the brachial plexus, and downwards to various parts, some of them probably to the heart.

VIII. *Cardiac Acceleration by stimulation of the Sympathetic.*

1. Stimulation of the sympathetic above the middle cervical ganglion produces no decided and constant effects on the cardiac rhythm; but influences the eye as in the Terrapin and land tortoise, *i.e.*, the lower lid is depresssed and the upper lid elevated; at the same time, the pupil is moderately dilated. In consequence of the imperfect development of the nictiating membrane in the sea-turtle, little effect is seen in this structure; the dilation of the pupil has seemed to me to be less marked than in the Terrapin. It has now been shown that in all the Chelonians the main sympathetic has throughout similar functions, not only on the heart but on the eye.

2. Stimulation of the branch from the middle cervical ganglion has produced more constant effects than the cor-

responding one in the Terrapin; but, generally, the increase, in force of the cardiac beat has been greater than the increase in rate.

3. Stimulation of the ganglion cardiacum basale, or the main stem beyond it, to the next metamere below, gives decided accelerating effects.

I have thought that stimulation of branches from this ganglion connected with the brachial plexus had accelerating effects, but of this I do not feel quite certain. The same laws as have been laid down for vagus acceleration apply in this case, especially the law of inverse proportion.

IX. *Further comparison of the Chelonians.*

By way of comparison, I have made a series of experiments on a limited number of specimens of one genus of land tortoise (*Pyxis*).

In most respects, the heart of this tortoise behaves more like that of the Terrapin than of the sea-turtle. The heart's general appearance is also more like that of the former. In the sea-turtles, some species have the ligament at the apex of the heart very highly developed, fibrous bands extending often half way up the ventral surface of the ventricle; and with great breadth of apical attachment. The ventricle is also, in the sea-turtles, paler, of less vitality and much more sensitive, as before pointed out, than in the other Chelonians.

In the specimens of the land tortoise examined by me, the holding power of the left vagus has been less than the right, and I think such differences are better marked than in the water tortoises or marine turtles.

The superiority of the right auricle has been better shown in the marine turtles than in the other Chelonians I have studied.

The independent rhythmic tendencies are greater in the land tortoise, I am inclined to believe, than in most other Chelonians.

The land tortoise and Terrapin resemble each other more than they do the marine turtles in the amount of dilation following direct faradisation of the heart; also neither the Terrapin's nor the land tortoise's heart enter with the same facility into intervermiform action as the sea turtle's.

Prolonged stimulation of the vagus has not led, in the land tortoise, to such pronounced results, as regards cardiac inhibition, in the few cases examined by me, as in other Chelonians.

The Chelonians constitute morphologically a very compact group, and it will be seen that the resemblances in the physiological behavior of this group is in accord with their anatomical likeness. It has been pointed out several times, that *C. Mydas* is physiologically more closely related to the Terrapin than the other species of sea-turtles I have studied; and it is in this one that the most anatomical resemblance, as far as the cardiac nerves are concerned, is found.

Throughout this paper, differences in the physiological behaviour of different species and genera of Chelonians have been pointed out; but it must be remarked that many minor variations, readily discernible by the eye, but not easily expressed in words, have been noticed during the year over which these investigations have extended.

The explanation of the different action of drugs on animals closely related anatomically, may possibly be reached by some such comparison as I have endeavored to carry out for the Chelonians.

EXPLANATION OF PLATE.

Fig. I. Relations of the sympathetic, vagus, &c., in *Chelonia imbricata* and *C. caretta*. S., sympathetic; V., vagus; *g.c.s.*, ganglion cerv. super.; *a. car.*, arteria carotida; *g. v.*, ganglion of the vagus stem; *g. c. m.*, ganglion cerv. med.; *g. c. b.*, ganglion cardiac. basal,; *acc. s.*, accelerating symp. branch. *a. v.*, arteria vertebralis: ix, x. refer to the metamere concerned.

Fig. 2. The vagus ganglion with its leash of branches. *a. s.*, art. subclavia.

Fig. 3. Shows partial fusion of *g.c.i.*, the gang. cerv. infer., and *g.t.p.*, the gang. thoracic. prim.

Fig. 4. The sympathetic, &c., in the *Terrapin*: to a large extent the same in *Chelonia mydas*. The lettering, as in previous figures. The dotted line between *g.c.i.* and *g.c.b.* indicates that a branch, sometimes present, completes an *annulus Vieussenii.*

Fig. 5. Ventricle with areas marked off by dotted lines, the numbers indicating the order in which these areas die.

Chemical Notes on Wheat and Flour.

By J. T. Donald, M.A.

(Read before the Natural History Society, Montreal, January 31, 1887.)

The quantity of flour used in the preparation of the staple bread is so much in excess of that used for all other purposes, that any examination of flour as a commercial article must necessarily be made from the point of view of its bread-making qualities.

In the baker's estimation, strength and color are the most important qualities of flour. In the matter of color alone, the whiter a flour the better. Strength is a term employed not always in precisely the same sense, but by it is generally meant the "capacity of a flour for producing a well risen loaf." For bakery use it is, I believe, impossible to obtain a flour that is too strong, and the flour most in demand for bread making is that known as "strong bakers'." The baker's demand for "strong" flour begets the miller's search for a "hard" wheat, for experience has shown that it is only from a "hard" wheat that a "strong" flour can be obtained; soft wheat yielding a flour deficient in strength.

The hardness and softness of wheat and strength of flour are physical characters, but they correspond to important differences in the chemical composition of the grain and flour. A "hard" wheat and a "strong" flour are always richer in nitrogen than a soft wheat and a weak flour, and of this greater amount of nitrogen in the "hard" wheat and "strong" flour a larger percentage is insoluble albuminoids or gluten than is the case in the soft wheat and weak flour. *The average nitrogen yielded by analysis of a series of soft Canadian wheat was 1.74 p.c., whilst a series of hard Manitoba wheat averaged 2.32 p.c. nitrogen. A sample of hard wheat from Portage la Prairie yielded moist gluten 36.43 p.c.; a soft wheat from Gretna gave, by similar treatment, only a shade under 25 p.c. or 24.96 p.c.

* U.S. Dept. Agriculture, Bureau of Chemistry Bulletin, No. 4, page 30.

Flour made in this city, branded "strong bakers", gave moist gluten 32.00 p.c., dry 12.41 p.c., whilst a sample, which would not rank as bakers' from same milling gave only 28.78 p.c. moist gluten, and 9.27 p.c. dry.

The connection between "hard" wheat and "strong" flour is thus clear, but the question will arise, why should some wheats be soft and others hard? This question I am unable to answer, but I wish to present certain facts connected, I think, with the solution of the problem, in the hope that some of our members, reasoning from these facts, may throw light upon the subject. It is true there are certain wheats which, however they may have become so, are now soft varieties and tend to reproduce a soft wheat, whilst other varieties known as hard tend to reproduce hard. But we also find that a wheat which in one part of the country will reproduce a hard grain, will in another locality yield a soft. And still further, a locality which in one season yields hard wheat, will, in a succeeding one, from similar seed, produce a soft grain.

The officers of the Bureau of Chemistry in the U.S. Dept. of Agriculture, have made an exhaustive examination of wheats collected from all parts of the Union, from which it appears that as we proceed from the eastern seaboard westward, the wheat is harder and harder until the States on the Pacific slope are reached, where the wheat of the country is again soft. In our own country, every miller knows that Ontario wheat is soft, and that for the production of a strong flour, western wheat must be used. (I am told, however, that there is a small area near Ottawa which produces a very hard wheat.) But all western wheat is not hard. A sample received from Gretna, a town south of Winnipeg, and just on the boundary line, is soft in comparison with a sample from Portage la Prairie, about fifty miles west of Winnipeg on the line of the C.P.R. These samples, on careful examination, will show that the hard wheat is darker in color than the soft—an experienced eye can easily detect the difference in the two samples.

With reference to this Portage la Prairie sample, I may add that wheat grown in the same neighbourhood last summer, i.e., summer of 1886, has shown traces of softness. The theory that this was caused by the extreme drought would be tenable if other localities in the Province had been affected in like manner, but other sections which last season produced wheat verging on soft have this season grown wheat of increased hardness. Specimens of wheat last fall, raised from No. 1 selected seed, showed from 40 p.c. to 50 p.c. soft. The wheat had a peculiar mottled appearance, some of the kernels being partly hard and partly soft. This was the case in many lots around Portage la Prairie. Still another point in this connection: spring wheat is always harder and yields a stronger flour than fall wheat. The Bureau of Chemistry, already referred to, reports that a sample of Dakota spring yields 14.35 p.c. albuminoids, whilst a fall variety from the same territory contains only 10.68 p.c. The analyst adds, "The weight of one hundred grains of the *winter* variety was 3.513 grams; of the *spring* grain, 2.755 grams. The smallness of size and richness in albuminoids may be due to a lack of starch owing to short period of growth and rapid maturity, and consequent inability to assimilate as much of the carbohydrates as the winter wheat." *

I may add that I am told by a gentleman who has travelled extensively through Manitoba and the Northwest, that when in a hard-wheat locality the grain does show signs of softness, it is in the grain grown on higher lands that softness first appears.

Turning now our attention to flour, we must remember that almost, if not, indeed, all merchant milling is conducted by roller milling process. In this process, the grain is passed through a series of rolls until the floury portion is separated from the germ and the coats, with whatever foreign matter may be adhering to the latter. The duty of the first set of rolls is to split the wheat along the crease, so that foreign matter within it may be removed by special appliances. The floury portion of the grain is separated from the coats in large particles, and these particles known

* Bulletin, No. 4, p. 19.

as "middlings" are ground between stones. Remembering that the coats of the wheat adhere very firmly to the floury material, and that the portion of the grain closely attached to the bran coats is the most highly nitrogenous of the whole, we can understand that this outer floury portion is to a certain extent carried away attached to bran, and that the flour from this part of the grain is so contaminated with small pieces of bran that the color is darker than the flour from the interior of grain. This darker flour, rich in gluten, forms "strong bakers'," while the whiter and less nitrogenous material is known as "patent." A third kind is known as "low grade." It is very dark in color, and contains numerous particles of bran and germ. Although highly nitrogenous, it contains only a low percentage of gluten, and will yield a very dark bread, owing both to presence of bran and germ and the action of the ferments present in them, which, during process of leavening, act upon the starch, converting it into dextrine and allied products.

The roller process is distinguished for the completeness with which it removes germ of the grain during manufacture of flour by flattening and sifting it out. The germ contains much ash, oil and nitrogen, and if allowed to be ground with the flour, darkens it by the presence of the oil, which is readily oxidised under certain conditions, and renders it very liable to fermentation, owing to the peculiar nitrogenous bodies which it carries.

In speaking of germ it may be noted that there is at present on the market an article known as "wheat germ meal," which is sold as a substitute for oatmeal for porridge, and for use in other forms. It is an excellent meal, extensively used in Winnipeg and other western cities. The name, however, is misleading, the substance has no connection with the germ. It is really "middlings," the particles of the floury portion of grain that are separated from the coats in passing through the rolls, and which are subsequently converted into flour by grinding between stones.

As already stated, from the roller mills three grades of flour are placed upon the market, known as *strong bakers'*, *patent* and *low grade.* The proportion of each depends upon the wheat that is used, and the particular market for which each grade is intended, and is varied at the discretion of the miller. An average percentage is about as follows:—32 p.c. patent, 4 p.c. low grade, and 64 p.c. bakers'.

The *strong bakers'* is richest in gluten, and somewhat dark in color owing to branny particles. A sample manufactured in this city gave 12.40 p.c. dry gluten. This grade is ordinarily used in making what is known among the bakers as the "brown" loaf. The large percentage of gluten enables the baker to produce with strong flour a large loaf which may be baked without pans.

Patent is a whiter flour, on account of fewer branny particles, and coming to a greater extent from inner part of grain has a lower percentage of gluten. A sample made at same time with sample *strong* just mentioned, yielded 9.20 p.c. dry gluten, whilst the *low grade* of the same milling showed only 6.30 p.c. dry gluten. The "patent" is the flour for family use, and the higher grades are used by bakers in the manufacture of white bread, loaves made in pans. Since this *patent* has not the high percentage of gluten found in *strong* loaves large and baked without pans cannot be so readily obtained from it.

Thus far I have spoken only of one cause of the strength of a flour, viz., the percentage of gluten, and so far as *bakers'*, *patent* and *low grade* from the same wheat are concerned, the quantity of gluten is a measure of the strength of the flour. But if a comparison is to be instituted between two samples of *bakers'* or of *patent,* or if it be necessary to determine the suitability of any flour for bakers' use, one must know not only the quantity of gluten the sample will yield, the quality of the gluten must be taken into consideration. In some flours the gluten is very firm and elastic, in others it is soft and sticky. In the latter case, a well risen loaf cannot be obtained, as the gas disengaged in fermentation is released by the soft gluten, whereas in the elastic gluten, a firm, porous mass is formed. The best test of quality of gluten is obtained by a trial baking; but some more rapid and convenient test is desirable, and to be of service to the baker in valuing his flour for strength must in character approximate to baking. An excellent test consists in exposing the gluten under proper conditions to such a temperature that the moisture of the moist gluten is vaporised, and in process of vaporisation and escape, expands the gluten. A soft, inelastic gluten readily allows the steam to pass out from the mass, whilst a firm, elastic gluten presents greater resistance to the steam, and is therefore expanded to a greater extent. The higher the quality of the gluten, the greater the expansion it undergoes.

I have yet to refer to the effect of frost on grain, and on the flour produced from such grain. This is an important point, inasmuch as for several seasons (excepting harvest of 1886) the wheat in many parts of the Northwest was injured by frost, and the Northwest is the great wheatfield of Canada, the feeder of the numerous mills in this and the adjacent Province of Ontario.

The effect of frost is seen in the bluish color and shrivelled appearance of the grain; the flour from such wheat is poor in gluten, and the quality of the diminished gluten is low. I am unable to indicate the precise changes which the constituents of the grain have undergone as result of being frozen. It seems that both the starchy and albuminoid matters of the grain are affected by frost. It seems probable that the frost directly acts upon the albuminoids, and through them upon the starch.

A sample of flour from frozen wheat yielded only 25 p.c. moist gluten, whilst flours obtained from similar wheats which had not been frozen, gave on analysis 27 and 28 p.c. moist gluten. Not only does freezing diminish the amount of gluten in the wheat, but it also affects the quality of the gluten. In flour from frozen wheat, the total amount of matter extracted by cold water in half an hour was 5.58 p.c., whereas in a sample of same grade from sound wheat, it was only 4.60 p.c., i.e., flour from frozen grain had nearly 25 p. c. more matter soluble in water than that from sound flour. The soluble albuminoids of the frozen amounted to 1.30 p.c., whereas in the flour from sound wheat, soluble albuminoids were only .95 p.c., i.e., flour from frozen grain had about 50 p.c. more soluble albuminoid matter than that from sound grain; clearly showing, I think, that frost had rendered soluble both gluten and starchy matter.

Why frost renders the gluten of wheat inelastic is uncertain. It may be that whilst a low temperature renders gluten soluble, a still lower coagulates to a greater or less extent the albuminoids, and coagulation is inimical to elasticity.

Be the cause what it may, the fact remains that flour from frozen grain contains a large percentage of soluble albuminoids and carbo-hydrates and a low percentage of gluten of slight elasticity.

In conclusion, I wish to call attention to a flour known as "Entire Wheat Flour," which its proprietors claim is neither a white nor a Graham flour, but a "flour of the entire food substance of wheat, and of that part only, discarding the innutritious husk or outer bran; a flour in which every food element of the wheat is preserved."

Undoubtedly the entire wheat flour contains a greater percentage of phosphates than ordinary flour, and perhaps of gluten, too, for it is a difficult matter to remove all the flour from the bran, and the flour near the bran is richer in gluten than is that of the interior of the grain, although the wheat is not girdled by a layer of gluten cells as proprietors of this flour and others believe. This supposed layer of gluten cells is really a layer of the bran in which is present a very active ferment known as *cerealin.* It is owing to the action of this ferment, not the presence of branny particles as such, that bread made from whole or entire meal is dark colored. "The dark color is due to excess of dextrinous matter derived from action of *cerealin* on starch. This excess of dextrine causes dough to become soft and clammy, on which account the loaf is apt to become sodden." To this dextrine is also due the sweetness of Graham or whole meal bread. It is often claimed for the whole meal bread that it is a remedy for dyspepsia; this claim I believe is well founded, not, I think, because such bread is more digestible than ordinary bread, but because the branny particles present cause irritation to such an extent that the bread is prematurely expelled from the digestive organs, and by this means the oppressive feeling of dyspepsia is removed. It follows, therefore, that although the "entire wheat flour," or whole meal, may contain more nourishment than white flour, the system is able to obtain more nutriment from the ordinary white flour.

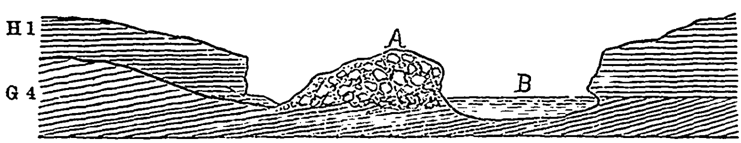
On a Permian Moraine in Prince Edward Island.

By F. Bain, Esq., North River, P.E.I.

The Trout River, which is the eastern branch of the Mill River, Prince Edward Island, flows in a deep and picturesque valley, cut through the horizontal Triassic strata which cap the rock formations of this part of the country. On either side of the stream, the rounded hills of fertile red sandstone rise two hundred feet, clothed with bright, deciduous groves or golden with the ripened fields of autumn. At the foot of these hills, at a place called Blackman's Island, a conspicuous ridge or mound, ten to twenty feet in height, fifty yards broad, and five hundred yards in length, runs along the left bank of the river, assuming much the appearance of a Quaternary glacial moraine. On examination, however, we find that it is formed by a hard mass of sandstone conglomerate, which has resisted denudation, while the surrounding softer strata have been carried away. A stratified portion at its base shows it to possess the same general dip as the Permian rocks of the district, viz., S. 22° E. $<$ 2°. General direction of the conglomerate ridge, S. 35° E. The superior beds, which once overlaid it, as seen in adjacent sections, are horizontal.

This ridge of ancient conglomerate is composed of rounded masses of red sandstone, sometimes two feet in diameter, gravel, sand and clay, with some fragments of primary drift, all intimately wrought up together, without any trace of stratification, except in the lower member mentioned. The whole is now consolidated into firm rock, hardened in part by carbonate of lime. It contains no organic remains, except that some of the included masses of sandstone show the usual traces of Permian conifers. It appears to me evidently to have been a glacial moraine of the close of the Permian. The large, rounded masses of stone, intimately wrought up with clay, sand and gravel, without stratification or other indication of sedimentary origin, I do not think can be referred to any other cause than that of ice operation. The angular fragments of primary rocks—quartzites and felsites—sometimes more than six inches in diameter, which it contains, show that the usual agents of a drift period were in operation, conveying material from great distances.

Section showing relation of Moraine to accompanying Formations.



A. Supposed Permian Moraine. B. Water level, Trout R.
H 1. Triassic Sandstone and Shales. G 4. Permian Sandstone.

The rounded blocks of sandstone contained in this deposit prove that at the time of its formation the underlying Permian strata had been consolidated into firm rock, and that a great lapse of time must have intervened between their deposition and its formation.

The deposits immediately succeeding this, and forming the base of the Trias, are of clay shale or shaly sandstone, and are nearly destitute of organisms. As we mount in the formation, however, more traces of life gradually come in, till at its summit, 200 or 300 feet above the horizon of the moraine, the dark-coloured sandstones bear evidence of an abundance of life, among which were tree ferns, stony corals and gigantic reptiles. On the other hand, the deposits immediately underlying the moraine, and forming the summit of the Permian, are very devoid of organized remains; but as we descend in the system, life becomes more abundant, until in the lower Permian we find the brown and grey rocks filled with the remains of a luxuriant vegetation, of which tree ferns and coniferous trees of the genus Dodoxylon formed an important feature.

The middle portion of this system of deposits, so devoid of organisms, forms a broad belt of red rocks widely distributed over the Island, forming its most characteristic red sandstone scenery, and appears to represent a period of depressed temperature in the past, which found its climax in a glacial period at the time of the formation of the ancient moraine. This line is specially interesting as being also the line of division between the Permian and Trias, where such a marked change in life is known to have taken place. Our ancient moraine, then, standing grim and sphinx-like by the glassy flow of the quiet Mill River, probably contains in its dark bosom the secret of that great change in life, viz., an era of glacial cold.

The Permian in England and in India bears evidence of extensive ice action, and it is exceedingly interesting to find the same in the Permian of Eastern Canada. In Europe the lower Permian shows generally a warm climate, though at its base is a line of drift material. The same line of drift material occurs at the base of the Permian in Prince Edward Island, followed by the same evidence of long-continued warm climate. The upper Permian in Europe indicates, by the absence of corals and the character of its mollusca, a cool climate. In Prince Edward Island we have seen that there is evidence of the same depression of temperature, which culminated in an era of ice and drift.

Life in the Bahama Islands.

By T. Wesley Mills, M. A., M. D.

Professor of Physiology, McGill University.

Having been invited to form one of a party of seven naturalists intending to visit the Bahama Islands last May, I gladly embraced the opportunity to learn something of that tropical region which so fascinates the imagination of every true lover of nature; the more so as we were to have the opportunity of seeing in operation those forces which explain the origin and growth of coral islands.

The expedition was headed by Professor Brooks of the Johns Hopkins University, under whose auspices we sailed, and to the wise generosity of which, science in America is so much indebted. There being no direct steam communication with Abaco, we were obliged to make use of a small sailing vessel, taking with us our laboratory outfit, and a supply of provisions sufficient for at least part of our intended stay. It was hoped that the voyage would not last longer than eight or ten days from Baltimore, our port of embarkation, but owing to stress of weather, contrary winds, etc., it extended over nineteen days. These days, however, were not without instruction. The tedious hours on deck were employed in observing the life around us, more especially such as we could capture by the hand-net.

Being obliged to put into harbor off the Carolina coast, we visited some small islands which were frequented by numerous sea-birds, especially gulls and terns. During our examination of these islands, it came to light that the people from the neighbouring coast were accustomed to visit them in the breeding season of the birds and gather the eggs in hundreds for food; so that the shooting of birds to supply ornaments for ladies' hats is not the only method of extermination practised. The capture of a white-rumped petrel, soaring near the deck, by a hand-net, was by the sailors assigned as the cause of all our misfortunes; such is the superstitious character of seamen to the present day.

Upon reaching the Gulf Stream, the increase in temperature necessitated a change to lighter garments. Sea captains immerse a thermometer in the water from time to time in order to ascertain when they strike the warm current.

The interest was maintained throughout by dipping up Gulf-weed, (*Sargassum bacciferum*), a fucoid in which numerous creatures take refuge, such as small barnacles, minute crabs and other crustaceans, nudibranch, tectibranch and heteropod mollusks, hydroids, together with small and beautiful fishes. The general resemblance of the creatures found to the weed itself was striking, though there were exceptions to this, a few forms being brightly colored, while *Sargassum* is of a faded green color. The Portuguese man-of-war (*Physalia*) was frequently to be seen floating by, his frail bark being trusted to the by no means smooth if not actually raging sea.

A form of medusa of the genus *Linerges* was met for several days while we were in the Gulf Stream, and it is singular that it should have appeared at about the same hour (4 p.m.) on each successive day. But of all our captures, none was more interesting than that of *Argonauta*, a female, provided therefore with shell, and, as it turned out, with eggs in the shell. When taken, it was alive, and having placed it in water in a glass vessel, its mode of locomotion, by jets of water forced through its siphon, could be observed beautifully. The sight of this was effective in somewhat reving some of the party sadly prostrated by sea-sickness. The creature was, of course, pickled with miserly care by the fortunate possessor.

At last, after so many days, which with all the interest we could put into them, were, from the want of accommodation, etc., on so small a vessel, weary ones, we sighted the Bahama "bank," took a pilot on board and began to revel in experiences at once the newest, most impressive, and in many respects the most delightful of our lives. A brief reference to the geography of the Bahamas may here be in place. This group of islands, keys and rocks lies between 21° and 27° N. latitude, and 72° and 79° W. longitude. One finds all transitions between the large island of Abaco and mere rocky projections; all are, however, of coral formation, and the keys are simply small islands, usually without vegetation, though some of the larger ones are densely covered with plant life. While the water over the reefs is nowhere deep, not often exceeding six fathoms, just ouside them the ocean has great depth. This abrupt change partially explains the danger to mariners, and shipwrecks are still too common.

We were bound for Green Turtle Key, which is separated from Abaco by about two miles of shallow water, one might say a sort of lagoon. This is the largest of the keys, measuring about a mile in length and less than a quarter of a mile at its widest part. Most of the small keys are uninhabited, but Green Turtle Key has a population of about 600.

The water over the "bank" or submerged coral formation is termed "white," except when green plants or colored algæ grow on the bottom, owing to its remarkable clearness. But viewed at a little distance, the surface of the water presents a beauty and variety of color related to the arrangement of clouds, etc., which it is impossible to express in words, and which a *series* of paintings might portray, though very inadequately.

Such is the transparency of the water, that with a "waterglass," objects lying on the bottom can be clearly discriminated at a depth of 4–5 fathoms; in fact we were accustomed to indicate by this means to our native diver exactly what we wanted him to bring up, a plan which was uniformly successful.

Having rented one of the largest houses on the key, it was fitted up as a laboratory and dwelling place combined. Our stay lasted through the month of June, which was an exceedingly busy time for us; we were in a new world, and daily fresh objects presented themselves for examination.

The rest of this paper will be devoted in great part to illustrating how largely the phenomena which have been associated with the formation of coral islands may be illustrated, in one small area. Here we find at once the requisite temperature (not below 68°), the clear water and the shallow depth, the conditions under which the coral animal flourishes. The teeming life now there explains the results of that which has been and which has determined conditions that render the existing life possible. In this paper, at all events, it will not be possible more than to glance at the subject in a general way. If the reader will suppose that he is sailing over the "bank" or submerged part of the reef, a distance of, say, two miles one way, and an equal distance in a direction at right angles to this, what may he expect to see on the bottom by the aid of his water-glass? The latter can be made very easily by puttying a pane of glass into one end of a rectangular wooden pipe two feet long and about six inches wide. He will pass several small keys, very much alike, but the ledges of each of which will be found to shelter myriads of marine creatures of every great group among the Invertebrates.

Over the bottom, dull white from the fine calcareous mud, may be seen in one part, Algæ of the most various shapes and colors, in which group here, owing to calcification, the plant bears a marked external resemblance to the Alcyonoid corals, which may be seen in some cases at no great distance, waving to and fro under the gently swaying water, the whole suggesting, as one looks down, a submerged garden.

In another area may be observed in masses large and small the branching Madrepore (*Madrepora cervicornis*); in still another region, Millepore and Fungoid corals, for it soon becomes evident that the conditions, over even so limited an area, do not suit each tribe equally well. Around and among the very branches of the dead corals especially may be seen representatives of all the different great divisions of the Echinoderms, many Mollusks, Crustaceans, Annelids, etc. While the Sponges may be found in many different regions, they have selected and flourished over certain parts of the bottom to such an extent, that the sponge fishing is very much confined to this quarter. However, Sponges may be seen growing almost everywhere, on coral stones, and even on offshoots of the Mangrove, which, by its peculiar habit of sending down branches into the mud of the bottom on the shores which it overhangs, and repeating this process again and again, forms a network for entrapping everything which may be washed up, thus becoming, as pointed out by Dana, a causative factor in the growth of coral islands.

After this hasty glance at the bottom, let us turn to the shore at low tide. The edges of the key have been undermined by the waves, and here in the little caves thus formed, and on the sides of the rocks, may be seen Crustaceans of every family, and among these, some of the large and peculiar forms which render museum collections objects of interest even to the scientifically uneducated. The spiny lobster (*Palinurus*) may be observed stealthily lurking under shelving rocks, below low water mark. Mollusks, the representatives of many families and genera, may be found on the sandy shores or attached to the rocky margins of the key. Conspicuous among these are the members of the peculiar Chiton family.

The shore is strewn with the most beautiful shells, no longer occupied by the animals which once carried them about; many of them to be taken possession of by the numerous genera of hermit crabs, which clamber over the rocks. Several hundred yards from the water's edge may be found a burrowing crab with powerful claws, rarely to be seen in daytime, though his nightwork leaves evidence palpable enough in the heaps of upturned sand. Not to speak of numerous peculiar and beautifully colored fishes to be observed in the coves referred to, an interesting member of the Cephalopods—the poulp (*Octopus*) abounds in the holes in the rocks which the waves have scooped out. From some study of this creature I am prepared to endorse the view that his intelligence is of a high order, a fact which one is prepared for, considering the mass and concentration of his nervous system.

So far as the formation of the coral island is concerned, I shall only refer to the action of forces that may now be observed in operation on even this small key. This island has increased in one direction, within the memory of the inhabitants who have reached the age of fifty, by some thirty yards. Beach formation, the work of the waves in grinding and comminuting the dead remains of corals, mollusks, crustaceans, etc., will account for this, probably without the assumption of any general or local elevation of the ocean bottom. One sees on every hand, the evidence of solution, cementing and comminution; and these are the processes which serve to explain the growth of coral islands. The waves, dashing up, erode small cavities; these are enlarged by the retained sea-water, which has remarkable solvent power over the calcium carbonate of which the whole key may be said to be composed; for it will be remembered that not only are the coral skeletons made up of this substance, but that the greater part of the hard remains of nearly all invertebrates is likewise of the same composition. By the cementing power of lime salts in solution, the shells of mollusks, etc., may be seen glued, either entire or in fragments, to the rocks of the key margins, so that a coral island is in reality a conglomerate with a fairly uniform chemical composition. It should be mentioned that on the shoals around this small island (key) the "King Conch" (*Strombus gigas*) is very abundant, and from the size and weight of its shell, it must contribute more to the formation of the calcareous total than could scores of other mollusks or of crustaceans.

But leaving the water and seeking for land animals, one may speedily dispose of the mammals, for there are none on Green Turtle Key, except a few dogs, cats, pigs, and probably rats and mice, though as to the latter I am not certain. Almost as numerous as the grasshopper with us is a small grayish-brown lizard of about 5–6 inches in length, with a handsome orange throat. Of land snakes there are none, I believe; turtles abound in the waters, and are much sought for food, as are also, their eggs, laid in the sand on the beach.

The tree-frog is found, but there are, of course, no fresh water ponds of any considerable size in which other tribes of Amphibians might live; if they exist here at all, their numbers must be very small. Excepting the common fly, the mosquito, spiders, centipedes, and cochroaches, land Arthropods are not abundant. The spiders, centipedes and cockroaches, however, attain an enormous size; and the latter fly about at night to the great annoyance of the unhappy mortal who is trying to fall asleep. The scorpion is found, living mostly amongst decaying vegetable matter; but it does not seem to attain its greatest size here; its sting is regarded by the inhabitants as serious, but not dangerous or fatal. The Lepidoptera are moderately well represented, some of the forms being large; and among the Hymenoptera, a large yellow-banded wasp is the most conspicuous.

On Abaco, a fly, resembling our common house-fly, but larger and with a more pointed abdomen, is a terrible blood sucker. Strangely enough, it is never found on Green Turtle Key, though only two miles distant. One of the natives told me that nothing could induce him to live on Abaco, on account of this fly.

Up to the present I have confined myself almost exclusively to Green Turtle Key, and the waters surrounding it. In referring to the bird and plant life, it may be more instructive to compare forms as found on the smaller and larger islands. Owing to the kindness of Mr. Jennings, the member of our party who has devoted most attention to the birds, I am in possession of accurate notes, from which the distribution of those birds found in the Bahamas by him may be learned. As much of the matter relating to the birds and plants must be in some degree new to science, it may be well to arrange it in more technical form than has been thought desirable in the other portions of this paper.

Mimocichla plumbea, "Blue Thrush," met with in Abaco but not seen on Green Turtle Key; habitat: Bahama Islands; common at New Providence, Andros, and Abaco.

Margarops fuscatus, a large thrush, belonging to the same family as the mocking-bird. Its habits are quite terrestrial, and its song is very sweet. It is found upon several of the West Indian Islands, seen upon one small key some distance from Abaco.

Mimus polyglottus, "Mocking-bird;" this species is very rare in Cuba, and Cory does not mention it as inhabiting any other of the West Indies. It is very common on Green Turtle Key; in N. A. it is found from the Atlantic to the Pacific as far north as 42°, but is not common north of 38°.

Certhiola bahamensis, Bahama Honey-creeper; is found in the Bahamas and Florida Keys; abundant on Green Turtle Key, and seen on No-Name Key and Abaco; the native name for this bird is "Tip-Toe."

Vireo altiloquus barbatulus, Black whiskered Greenlet. "Whip-tom-kelly," "Sweet-joe-clear;" habitat: Cuba, Bahamas and South Florida; met with once on Green Turtle Key, and at no other point.

Callichelidon cyaneoviridis; this pretty swallow is found in the Bahamas; it was common on Green Turtle Key and Abaco.

Spindalis zena townsendi; a beautifully marked bird, belonging to the family Tanagridae or the Tanagers. This species was abundant on Abaco, opposite Green Turtle Key, and two specimens were obtained on the latter. This bird was first taken by the naturalists of the U. S. Fish Commission Steamer "Albatross," early in 1886, and described by Mr. Ridgway.

Euetheia bicolor, "Parroquet;" this small finch is given its name by the natives on account of its appearance, which was absurdly like a very diminutive parroquet; habitat: Bahama Islands and Antilles; seen on Abaco only.

Argelaius phœniceus bryanti, the Bahaman form of the common red-winged blackbird; common on Green Turtle Key, but observed nowhere else.

Tyrannus dominicensis, Gray King Bird; habitat: West Indies and Florida; common on Green Turtle Key.

Chordeiles virginianus minor, Cuban Night-hawk; habitat: Antilles and Florida; common on most of the Abaco keys.

Crotophaga An., Black Witch, Savanna Blackbird: habitat: Tropical America, West Indies and Florida; several observed on Green Turtle Key.

Dryobates villosus insularis; a specimen of this small woodpecker was obtained on Green Turtle Key; habitat: Northern Bahama Islands.

Centuris blakei, a species of woodpecker, belonging to the same genus as the Red-bellied Woodpecker; it was first taken on Abaco by the "Albatross" party; our specimen was procured on Abaco.

Cathartes aura, Turkey Vulture; habitat: North and

South America; in North America from Atlantic to Pacific N. to 53°, resident N. to about 40°, occasional individuals N. to Nova Scotia and New Brunswick; one specimen seen on Abaco.

Columba leucocephala, White-crowned Pigeon; habitat: West Indies and Florida keys. Extremely abundant on some of the Abaco keys, though none seen on Green Turtle Key that could be identified as this species.

Columbigallina passerina, Ground Dove; habitat: Middle America, West Indies, South Atlantic and Gulf States, N. to Carolina; common on Green Turtle Key, and on other keys in the vicinity, and on Abaco.

Symphemia semipalmata, Willet; one specimen taken on Green Turtle Key; habitat: Temperate North America, Atlantic coast from Nova Scotia to Florida, West Indies and S. to Brazil.

Nycterodius-violaceus, White-crowned Night-heron; habitat: N. South America, West Indies and South Atlantic and Gulf Coasts, rarely N. to Middle States; Observed on Green Turtle, No-Name, and Fish Keys.

Phœnicopterus ruber, American Flamingo; habitat: Atlantic coast of Central America, N. to Florida and West Indies, rarely to South Carolina; recorded from Bermuda; found on Abaco.

Pelecanus fuscus, American Brown Pelican; habitat: Atlantic and Pacific coasts of tropical and sub-tropical America, north to Carolina and California; met with about most of the Abaco keys.

Phalacrocorax dilophus floridanus, Florida Cormorant; habitat: South Atlantic and Gulf coasts; found breeding on Hog Key.

Tachypetes aquilus; Frigate, Man-of-war Bird; habitat: coasts of tropical and sub-tropical America, north casually to Long Island; large flocks of these birds frequented Hog and Fish Keys, and occasionally individuals were seen at other places.

Phæton flavirostris, Yellow-billed Tropic Bird; habitat: Atlantic coast of Central America, N. to Florida and West Indies; met with at Hog and Fish Keys, and at one place on Abaco.

Larus atricilla, Black-headed or Laughing Gull; habitat: Atlantic coast of America, South to Lower Amazon, N. casually to Maine; common at Joe's, Fish, and other keys.

Sterna hirundo, Common Tern; habitat: East North America; common on several of the Abaco keys.

Sterna antillarum, Least Tern; habitat: warm temperate America, Central America, and West Indies; common on Abaco keys.

Sterna fuliginosa, Sooty Tern; its range extends over the warmer sea coasts of the globe; in America, N. to Carolina, casually to New England; extremely abundant at Fish key.

Sterna anæsthetica, Bridled Tern; its general range coincides with that of the last species, but in North America it is found in Florida only; procured at Lower Fish Keys, but it was not nearly so abundant as S. fuliginosa.

Among the birds, specimens of which were obtained but not yet identified, are a Grossbeak, two Warblers, a Parrot, a Dove, and two species of Humming-bird.

Green Turtle Key is densely covered with vegetation which is, however, in marked contrast with that of the adjacent large island of Abaco, by the absence of very large or forest trees. On Abaco may be found the pine, *Pinus Cubensis* (?) resembling *Pinus Tæda*, also the red cedar, *Juniperus Virginiana*; cedar prevails near the numerous swamps in the north-eastern part of the island; the pine may reach a height of 80 feet.

Among other common trees are the mastic, "dogwood," white torch, bullet, and "poison wood" (probably *Rhus toxicodendron.*)

In the lowest part of the island, the mangrove (*Rhizophora Mangle*) forms dense thickets.

Ferns, bromeliads and orchids flourish abundantly, both on Green Turtle Key and on Abaco.

The small keys are devoid of trees proper, but shrubs, vines, coarse grasses, etc., abound. Among these are turtle grass (*Gomphrena*), morning glories (*Convolvuli*), a pea vine with rope like stems (*Carnavalia.*)

A plant imported by florists, the "West Indian Lily" (*Pancratium*), grows along the sandy margins of many of the islands.

The "Button-wood" (*Conocarpus*), with its conspicuous silvery leaves, flourishes on every hand.

Green Turtle Key has the most varied flora of all, in proportion to its size, owing probably to the fact that it alone among the smaller islands is inhabited by man. The cocoanut palm flourishes in beauty and vigor at one end of the Key, though the natives make very little use of the fruit themselves.

One island, named Cocoanut Key, is covered with a grove of these trees, planted some seven years ago. One of the most interesting remembrances of the trip is that of a morning spent on this key, where the cocoanut palm may be seen in all stages of growth, from flowering to the production of the ripe fruit, while beneath the trees, the fallen parts suggest most plainly the economic uses to which the plant may be put. I could get no evidence that the cocoanut ever grows spontaneously in the Bahamas; it is in all cases planted, and does not bear fruit for six or seven years.

Many fruit trees now grow wild on Green Turtle Key, such as the banana, orange, lemon, sapodillo, mango, shaddock, mammee, custard apple (Pawpaw), hog plum, tamarind, date palm (rare), fig (rare.)

None of these can be said to be cultivated in the proper sense; they may, in fact, be found intermingled with shrubs, vines, etc., forming a thicket as dense as any in a Canadian forest, and when caught in one of them, I could not help making the comparison and at the same time noting the contrast.

Conspicuous on the low sandy region near the shore is the manilla, a species of Agave, with its powerful, long, spiked leaves, and its solitary flower stalk, which reaches a height of at least 20 feet.

In the same region, a cactus (*Opuntia*) abounds in large and dense masses. Insects, I observed, play a great part in the fertilization of the flowers of this plant.

One of our party, Mr. F. H. Herrick, collected and preserved a considerable number of plants. These were submitted for identification to Prof. Eaton and Mr. W. A. Setchell, of Yale College. The results of their work have appeared in the Johns Hopkins' circular, from which I extract the following table.

The sixty-six species of the list represent about forty natural orders or families.

Those plants marked by a †, constituting about one third of the whole, are not known to occur in the Southern States or on the Florida Keys and are, it is likely, peculiar to the Bahamas.

Plants found on Abaco alone are marked accordingly, and those observed only on Green Turtle Key are marked by the letters G. T. Local, popular names are enclosed in quotation marks.

FLOWERING PLANTS.

1, *Agave* sps (?). "Manilla Plant."
† 2. *Alternanthera flavescens*, Moquin.
3. *Argemone Mexicana*, L. Prickly Poppy. (G. T.)
4. *Artemisia vulgaris*, L. Common Mugwort, (G. T.)
† 5. *A. hispida*, Pursh. "Bastard Geranium."
6. *Asclepias paupercula*, Michx. Milkweed.
7. *Bidens leucantha*, W. Beggars' Ticks.
8. *Borrichia arborescens*, *D. C.*. "Bay Lavender."
† 9. *Brumfelsia*—(?). Tall shrub.
10. *Carnavalia obtusifolia*, D. C, Coarse vine (Pea family).
†11. *Catopsis nutans*, Gris. (?). Epiphytic Bromeliad. "Wild Pine." (Abaco.)
†12. *Cenchorus hirsutus*, L. "Courage Bush."
†13. *Cenchrus tribuloides*, L. (Grass).
†14. *Cladium occidentale*, Schrader. (Sedge).
†15. *Coccoloba uvifera*. Shrub or small tree. "Sea Grape."
16. *Conocarpus erectus*, L. V. *erectus*, Gris. "Button-wood."
17. *Cyperus Vahlii*, Stendel.
18. *Datura stramonium*, L. Jamestown Weed. (G. T.)
19. *Dichromena leucocephala*. Michx. (Sedge). (Abaco).
†20. *Echites suberecta*. Common Climber.
†21. *Eupatorium integrifolium*, Berb.
22. *Euphorbia* sps (?). "Milkweed."
†23. *Eunodia littoralis*, Swtz.
†24. *Ficus trigonata*. "Wild Fig.." (G. T.)
25. *Fimbristylis spadicea*, Vahl. (Sedge).
†26. *Genipa clusifolia*, Gris. "Seven-year Apple."
27. *Gomphrena*—(?). "Turtle Grass."
28. *Jacquinia armillaris*, Jacq. "Joe-Bush."

29. *Juniperus Virginiana*, L. Red Cedar.
†30. *Lantana involucrata*, L. Low shrub.
31. *Lepidium Virginicum*, L. (G. T.) Pepper grass.
32. *Malvaviscus arboreus*, Cas. "Red Cherry." Shrub.
33. *Melanthera deltoidea*, Michx.
34. *Melia Azederach*, L. "Pride of Winter." China Tree.
†35. *Oncidium Guibertianum*, Rich. Epiphytic Orchid, (Abaco).
36. *Opuntia* (?). "Prickly Pear." Cactus.
†37. *Pancratium Carolinianum*, L. "Lily." (Amarillis family).
†38. *Passiflora cupraea*. L. (Pawpaw Key). Passion Flower.
39. *Pimpinella Anisum*. Anise. (G. T.)
†40. *Pinus Cubensis*, Gris. (?). (Abaco).
41. *Plantago major*, L. (G. T.) Common Plantain.
†42. *Rhacicallis rupestris*, D. C. "Seaweed."
43. *Rhizophora Mangle*, L. Mangrove.
44. *Rhus*—(?). "Poison Wood."
45. *Ricinus communis*, L. Castor-oil Plant. (G. T.)
46. *Sabbatia gracilis*, Pursh. (Joe's Cay).
†47. *Sapota Achras*, Miller. "Wild sapodilla."
48. *Scaevolo Plumieri*, Vahl. Low shrub.
49. *Smilax Havanensis*, Jacq.
50. *Solanum aculeatissimum*, Jacq. Apple of Sodom. (G. T.)
51. *Stenotaphrum Americanum*, Schrank. (Grass).
52. *Strumpfia maritima*, Jacq. Low shrub.
†53. *Suæda linearis*, Torr.
†54. *Tetrazygia eleagnoides*. D. C. "Black Torch-berry."
†55. *Tillandsia canescens*, Sw. (?). "Wild Pine." (Abaco).
56. *T. bulbosa*, Hook. "Wild Pine," (Abaco).
57. *Uniola paniculata*, L. Spike Grass.
58. *Verbascum pulverulentum*. Mullein. (G. T.)
59. *Vincetoxicum palustre*, Gray.

FERNS.

60. *Acrostichum aureum*. L. (Abaco).
61. *Adiantum tenerum*, Swz. (Abaco).
62. *Aneimia adiantifolia*, Swz. (Abaco and G. T.)
63. *Aspidium patens*, Swz. (Abaco);
†64. *Davallia clavata*, Swz. (Abaco).
65. *Polypodium incanum*, Swz. (Abaco, on trees).
66. *Tænites lanceolata*, R. Br. (Abaco, on trees).

It should be mentioned that while the banana abounds, the pine-apple (*Ananassa sativa*) is the only fruit grown for exportation by the inhabitants of this portion of the Bahamas. The plantations are principally on Abaco.

One of the most important scientific results of the expedition remains to be noted. Up to last summer, the development of the Stomatopods had never been traced from the eggs, owing propably to the difficulty of obtaining the latter, for these crustaceans do not carry their eggs about with them, but deposit them in their usually inaccessible burrows; but the softness of the coral rock permits of its being broken up, and in this way a supply of eggs was obtained by Prof. Brooks, who was able to work out their development in part at Green Turtle Key and to continue it on preserved material during this past winter. Morphologists will await the results of this investigation with unusual interest.

Illustrations of the Fauna of the St. John Group.

No. 4.—On the smaller eyed Trilobites of Division I., with a few remarks on the species of the higher divisions of the group.

By G. F. Matthew, M.A., F.R.S.C.

A.—The smaller eyed Trilobites of Division I.

(*Abstract.*)

The Trilobites described in this paper include representatives of the genera Ellipsocephalus, Agraulos, (or Arionellus) Liostracus,* Ptychoparia and Solenopleura. These genera, and especially Liostracus and Ptychoparia, are closely related. From a study of the young of these two genera, it would appear that Ellipsocephalus retains some features which are not so prominent in the young or adult of the other kinds, especially the eyelobe extending far towards the back of the head, as in the oldest types of Para-

*The two species here referred to Liostracus probably represent a new genus, or perhaps Angelin's original genus, for it is difficult to see how Liostracus, as defined by Linnarsson and Brögger, differs from Ptychoparia, and from this genus the one in the St. John group is distinct.

doxides. In other respects this genus (Ellipsocephalus) appears to be the most primitive type of the group of species to which this paper relates; its pleuræ are short and but little bent or pointed, its glabella is long and prominent, the facial suture is short and distant from the glabella, and the occipital furrow is faint.

The changes during growth in Liostracus and Ptychoparia are suggestive, and may be briefly presented as follows:—Omitting the first stage, indicated in all these trilobites, but which cannot be said to be special to any one, namely that in which the test of the creature is represented by an oval body with an umbilicus-like depression, one may first speak of a phase of the growing embryo in which the rachis is distinctly raised throughout its whole length and the cephalic shield, and the pygidium, indicated by a strong groove across the axis, about two-thirds or three-quarters of its whole length, from the front of the embryo. At this stage, the occipital ring is faintly outlined by a shallow groove across the rachis, and a similar, but fainter groove, indicates the first ring of the axis of the pygidium. The cheeks of the cephalic shield and the side lobes of the pygidium still form a continuous, rounded surface, except that in some examples these two parts of the body are indicated on the side lobes of the test by a faint transverse line. At this stage we are unable to distinguish even the family of the trilobite by the form of its test, for with its single ring in the pygidial part, and the enlarged front of the anterior end of the axis in the cephalic portion of the embryo, the later stages may as well exhibit to us a Conocoryphean as a Ptychoparian trilobite.

In the next stage of growth in which the cephalic shield and the pygidium are entirely separated, features appear in the former which enable one to distinguish the trilobites of this family from the Conocoryphidæ, these are the less perfectly semi-circular form of the cephalic shield, the greater prominence and comparatively larger size of the glabella, and the presence of eyelobes. At this stage in Ptychoparia and Liostracus, the dorsal suture is much nearer the margin than in the adult, a point in which these young tests resemble the adult in Ellipsocephalus and Agraulos.* The ocular fillet in these minute head shields appears close to the anterior margin, as in the Conocorypheans, but the development of the anterior limb of the cheeks in the later stages pushes it backward. In the advanced position of the ocular fillet, as well as in the long and prominent glabella in these little tests, we are again reminded of Ellipsocephalus, but a counterpart of the straight facial suture and the short eyelobe, comparatively distant from the posterior margin, is to be found in Agraulos, rather than Ellipsocephalus.

The form of the anterior margin in these young tests exhibits affinities in another direction, for in the depressed front, with narrow, sharp, threadlike marginal fold, which appears at this stage of growth, there is a counterpart to the same portion of the shield in the adult of Liostracus and Solenopleura.

The two genera last named with Ptychoparia exhibit an important departure from the primitive type in the withdrawal, during growth, of the eyelobe from the vicinity of the lateral margin, of the shield toward the side of the glabella. From this position of the eyelobe results an extension of the posterior margin of the middle piece of the headshield, a character which is most pronounced in the species of pelagic habits, and which extension is accompanied by a corresponding prolongation of the pleuræ.

Another change which occurs during growth, namely, the contraction or shortening of the eyelobe, is one which, among the genera under review, is most obvious in Solenopleura; and this genus stands out from the others also in the inflation or enlargement of the cheeks at the expense of the glabella, and in the ornamentation of the test by tubercles and granulations.

These three peculiarities of certain of these early trilobites, viz., the withdrawal of the eyelobe towards the

* The references herein to the standing of Agraulos relate to the species which are near in form to the type, but there is a species in the lower part of Div. I. which combines the characters of this genus with those of Ellipsocephalus.

glabella, the shortening of the eyelobe, and the more profuse ornamentation of the test, are most noticeable in those species, whose remains are entombed in the fine dark-grey argillaceous sediments, and least observable in those found in coarse shale and sandstone.

As regards the most salient characters of the five genera above-named, they may be arranged as follows:—

Genera having the most primitive suture ..	Ellipsocephalus. Agraulos.
Genera most completely representative of the average characters of the group....	Liostracus. Ptychoparia.
Genus exhibiting the widest departure from the primitive type.............	Solenopleura.

How much is yet to be learned respecting the origin of the Cambrian fauna! With the extensive and careful researches which have been made during the last score of years in the oldest sedimentary rocks, how little has been accomplished toward piercing the wall of barren formations that severs the Eozoon of the Laurentian system from the earliest primordial forms! It can hardly be that a fauna which blossomed out into such a variety of types at the base of the Cambrian System had there its beginning. Here, in the Paradoxides Zone, the species of animals, both in Europe and America, have a strong representative aspect, but only a limited number are found to be identical. There is a similar, though not identical succession of forms, in the several members or groups of strata which compose this zone, as if a stream of new species were coming in on both sides of the Atlantic; and yet certain genera which are found in the deposits of one continent are not to be met with in those of the other. With these facts before us, the dictum that Life originated in the Primordial Zone seems untenable.

On the contrary, we are lead to surmise that at some other point on the surface of the globe than any which has yet been explored, the ancestors of the Primordial Fauna will yet be found: it may be years before it shall be recovered, and in lieu of actual knowledge, inferences based on the study of the embryological forms of the species of the Primordial Fauna are a means of bringing before our mental vision a conception of what that fauna may have been. Dr. Henry Hicks has surmised that the Cambrian Fauna came from the central region of the North Atlantic Ocean, invading the continental margins on each side of the oceanic area; but whatever its origin, it would appear that the fauna reached Europe and America by independent routes, if we may judge by the representative species present in the two continents.

The following is a rough estimate of the number of animals in the several orders which have so far been found in Division I. of the St. John Group; it shows that the fauna is thoroughly representative of the earliest Cambrian stage, being characterized by the great preponderance of the trilobites over all other forms, and by the prevalence of brachiopods with horny shells. This list is not to be regarded as final.

CLASSES AND ORDERS OF ANIMALS IN DIVISION I.

	Genera.	Species.	Varieties
Rhizopoda (Sponges, &c.)	3	3	1
Hydrozoa (Graptolites, &c.)............	2	2	
Echinodermata (Cystidians)	1	1	
Brachiopoda (Lamp shells, &c.)	6	12	2
Pteropoda (Sea butterflies, &c.).........	2	5	4
Gasteropoda (Sea snails, &c)...........	2	7	
Crustacea (Crustaceans)	14	35	14
	30	65	21

	Genera.	Species	Var.
Order Phyllopoda .	2	3	
" Ostracoda ..	3	4	
" Trilobita ...	9	28	14
	14	35	14

The appearance and disappearance or extinction of the genera and species composing the above fauna is shown by the following statement of the composition of the subfaunas existing in Division I., so far as this has been ascertained :—

RANGE OF GENERA.

Genera peculiar to Band *b*	5		
" that pass from *b* to *c*	5—10		
" peculiar to *c*	7		
" that pass from *c* to *d*	15—22—32		
Deduct genera common to *b*, *c* and *d*			5
			27
Add genera peculiar to *d*			3
Total number of genera			30

RANGE OF SPECIES.

Species peculiar to Band *b*	6		
" that pass from *b* to *c*	5—11		
" peculiar to *c*	29		
" that pass to *d*	6		
" " " by varieties	7—42—53		
Deduct species common to *b*, *c* and *d*			4
			49
Add species peculiar to *d*			16
Total number of species			65

B.—PRELIMINARY NOTES ON THE HIGHER CAMBRIAN FAUNAS OF THE ACADIAN REGION.

Owing to the prevalence of shallow water conditions in the St. John basin during much of the time in which its deposits were forming, it is not easy to distinguish the upward limit of the formation, or to say how much of Cambrian time is represented in its deposits; it is highly probable, however, that it covers nearly the whole of the Cambrian age, as the Ctenopyge beds, whose place is shown further on, consist of a great mass of fine-grained, dark grey and black, slaty shales, which are undoubtedly deep water deposits. Burrows and trails of sea-worms, and shells of Lingulella, etc., are found in the sandy beds above and below these Ctenopyge shales. By means of the Ctenopyge beds, and by what is known of the Cambrian fauna in Cape Breton, the author is able to indicate the position of some of the faunas which lie at higher levels than those hitherto observed in the Acadian Cambrian rocks.

Of the true Oleni no examples have yet been found in Acadia, but the fauna of the upper part of the Lingula Flags (=the upper part of Regio A of Angelin) is present both in the St. John basin and in Cape Breton. In the former area the fossils are found in calcareous nodules, "lentiles," etc., and beside a Ctenopyge allied to *C. spectabilis*, there are several species of Brachiopods (Kutorgina, Orthis, etc). In Cape Breton, the measures are fine shales, with calcareous layers, and contain *Peltura scarabeoides*, *Sphæropthalmus alatus*, etc. In the Kennebecasis basin, near St. John, there are also beds with brachiopods and trilobites belonging to the Middle or Upper Cambrian.

The following list will show what European horizons have been recognized and what are still unknown in Acadia:

Fauna with	Ceratopyge........................	Unknown.
Do.	Peltura	Cape Breton.
Do.	Ctenopyge	St. John Basin.
Do.	Olenus........................	Unknown.
Do.	Paradoxides Forchammeri....	do.
Do.	P. Abenacus (near Tessini)....	St. John Basin.
Do.	P. Eteminicus (near rugulosus)	do.
Do.	of earlier date (probably the equivalent of that holding P. Kjerulfi)........................	do.

The fauna of the Potsdam Sandstone, which may be regarded as equivalent to that of the Ceratopyge beds, has not been recognized in the Acadian region. Above the Ceratopyge beds are found in Europe the shales containing the first of the true graptolitic faunas, and with this, or after this, come in the trilobites of the Second Fauna. The deep water faunas noted in the above noted list as missing may be accounted for by the shallow water beds in the St. John basin, there being two masses of such beds in the sediments that were accumulated in this basin.

NOTE ON THE OCCURRENCE OF JADE IN BRITISH COLUMBIA, AND ITS EMPLOYMENT BY THE NATIVES,

BY GEORGE M. DAWSON,

WITH QUOTATIONS AND EXTRACTS FROM A PAPER BY PROF. A. B. MEYER, ON NEPHRITE AND ANALOGOUS MINERALS FROM ALASKA.

From the Strait of Fuca northward along the entire coast of British Columbia and Alaska to the Arctic Sea, implements of jade or closely allied materials are found in considerable numbers, either in association with relics of various kinds, in shell-heaps and about old village sites, or in other cases still preserved, though scarcely now used, by the natives. Of implements which may collectively be designated as "adzes" or "celts;" those of jade form a considerable proportion of the whole. Jade is also found, in a similar manner, at least as far inland as the second mountain system of the Cordillera belt—that represented by the Gold, Cariboo and other ranges—and is notably abundant among specimens from Indian graves, etc., along the lower portions of the Fraser and Thompson Rivers, within the territory of the people of Selish stock. Elsewhere in the interior of the province, jade implements are rarer, a circumstance probably in part to be accounted for by the fact that adzes or adze-like tools have not been so much employed by the interior Indians as by those of the coast, who are pre-eminent as dexterous workers in wood, and noted for the size and superior construction of their wooden houses and canoes.

While jade was evidently a material highly prized and carefully hoarded, the aggregate quantity of this mineral in use by the Indians and Eskimo of the coast at any one time previous to the introduction of iron tools among these peoples, must have been very great—so great as to clearly indicate that its origin is proximately local, and to preclude a belief in the theory that it was obtained casually, or in the course of trade, from remote sources. The facts are indeed such as to fully bear out the autochthonous origin of this material, which has on several occasions been ably contended for by Prof. A. B. Meyer, of Dresden, whose remarks on this point, bearing on this particular district, are quoted further on. In addition to the facts above stated, it may be added that the numerous jade implements which have been examined from different parts of the coast and from the Fraser valley, give evidence among themselves of local peculiarities of colour and texture.

Though much valued, I am not aware that there is any reason to believe that superstitious or sentimental feelings have been entertained respecting jade by the natives. In the absence of metals, its useful properties were alone sufficient to recommend it to their attention, as it is the best available non-metallic material from which to manufacture tools with permanent cutting edges. Its compactness in texture and toughness are very considerable, its hardness (6·5 to 7) greater than that of ordinary steel, and as great as is compatible with grinding down or sharpening with the only substance in the possession of the natives for that purpose—quartz or silicious rocks.

My attention has been specially drawn to the use of jade by the Indians, by the occurrence of two partly worked small boulders of that material on the lower part of the Fraser (at Lytton and Yale respectively), and the discovery in 1877, in old Indian graves near Lytton, of evidence that the manufacture of adzes had there been actually carried on. These facts seem to point to the valley of the lower Fraser or to that of its tributary, the Thompson, as one, at least, of the localities from which jade has been derived, though, so far as I am aware, it has not yet been found *in situ* in any part of British Columbia. The partly worked boulders to which allusion has been made, are more particularly described below. They resemble in shape and size the well rounded stones which are abundant in rough beaches along the more rapid parts of the Fraser River, and present a peculiarity in polish which is often found to characterize these stones, and which appears to be due to the action of the sand which is drifted by the wind along these beaches during periods of low water. All the circumstances, in fact, tend to show that they may have been picked up on the immediately adjacent banks of the river.

The term jade is here used in a somewhat general sense, as no exhaustive mineralogical examination of the various specimens has been attempted, though a typical piece of the Fraser River mineral from the vicinity of Lytton, which has been examined by Dr. B. J. Harrington, proves to be a true nephrite, and other analyses of specimens from the same region render it probable that most, if not all the jade there found, is referable to the same species. The implements here collectively classed as jade all have, however, the characteristic lustre, texture and fracture of that mineral, and a mineralogical hardness of between 6 and 7. The colours represented are very varied, as the subjoined enumeration will show, and several more or less blended tints often occur in the same specimen. The implements and fragments here particularly referred to, are those derived from the region above defined, which are in the museum of the Geological Survey of Canada, or deposited in the Peter Redpath museum of McGill College, in Montreal. The stones of a pale gray or whitish colour, of which the examples occur in the collection of Mr. F. Mercier, in the first named museum, are all from the northern part of Alaska, and are with little doubt to be classed as pectolite, as stated by Professor Meyer in passages subsequently quoted.

The specimens referred to, classified according to colour, arrange themselves as below:—

Grey-greens to greenish greys, pale and dark, generally streaked or mottled; translucent to sub-translucent and opaque	23
Dark greens, varying from leek-green to sap-green, and generally translucent	15
Browns, shading to greenish and greyish, generally streaked, opaque	7
Pale bluish and and yellowish greens, translucent....	6
Greyish-blue and bluish-grey, translucent (probably pectolite)	6
Green and grey, and green and black, mottled.......	4
	61

The same series of specimens, classified according to form and use, show the following proportions:—

Adzes	44
Drill-points or borers (all from Alaska)	6
Cut boulders	2

Sockets for fire-drills (both from Alaska)............	2
Mallets (both from Alaska, and probably pectolite) ...	2
Fragments	2
Spear head (?)	1
Burnisher or whetstone (from Alaska, and probably pectolite)	1
Pendant (from Alaska, and probably pectolite)	1
	61

Of the above specimens, sixty-one in number, seventeen show evidence, more or less distinct, of having been sawn in the manner subsequently noticed.

The chemical composition of jade is such as to show that it can scarcely be supposed to have originated from the usual materials of sedimentary rocks* by ordinary processes of metamorphism. The origin of a mineral of this kind must be sought among rocks immediately or proximately of eruptive origin, in connection with certain classes of which (as, for instance, minerals of the pyroxene group) it may reasonably be supposed to have arisen as an alteration product. This view appears to be borne out by an examination of the suites of specimens of which those here classed as jade form a part. Some of these specimens are perfectly homogenous and structureless to the eye, consisting apparently of pure translucent jade. Others are clouded or variegated in colour, more opaque, and becoming in some instances distinctly laminated. A few exhibit on polished surfaces, at right angles to the planes of lamination, a minutely lenticular structure, as though granules varying in composition or colour had been welded together by pressure acting in a single direction, in the manner frequently observed in fragmental volcanic rocks. One or two specimens, which though apparently forming terms of the same series with the jades, can scarcely be classed as such, are pretty evidently of fragmental origin, and have the appearance of altered volcanic ashes or sand. None of the examples show any definite evidence of having been veinstones.

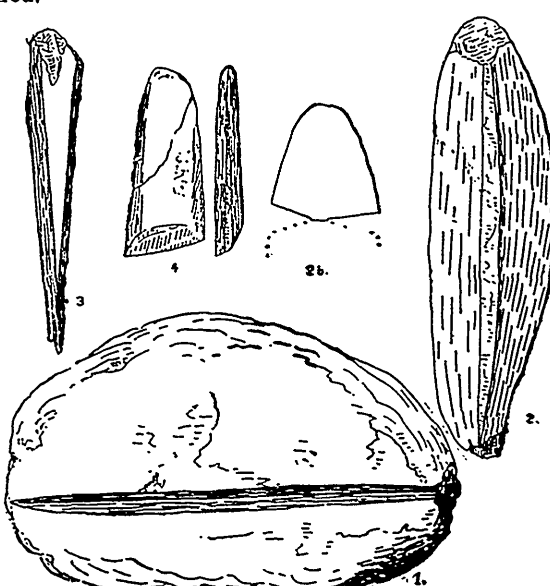
If it be admitted that jade has resulted from the alteration

* It seems reasonable to exclude from this class certain rocks occurring among the older crystalline schists, the material of which has very possibly been originally volcanic.

of minerals or materials of eruptive origin, the important part which volcanic rocks play in the portion of the Cordillera belt which is included in British Columbia, and the great amount of alteration which some of these have suffered, go far to explain the abundance of jade implements among the natives of the same region, while the great continuity of identical geological conditions in a direction parallel to the coast, may well go hand in hand with the abundance of jade implements actually occurring along the same line. In the province of British Columbia, we find volcanic rocks forming considerable portions of at least five distinct geological systems, viz., the Cambrian, Carboniferous, Triassic, Cretaceous and Miocene. Of these, the first and last may be excluded from consideration; the Cambrian as not yet recognised in the districts in which jade tools are found, the Miocene as being in general, if not in all cases, in a nearly unaltered state. It is among the highly altered and recomposed volcanic rocks of the Carboniferous and Triassic, that silicates of the jade class might be expected to occur; and I feel little doubt that when these rocks are carefully investigated, they will be found to be the sources of the jade, though the Indians of the region have usually, if not invariably, obtained their supply from loose fragments and boulders.

The peculiar adaptability of jade to the manufacture of implements is shown by the mode of working it which has been in use by the natives, which is clearly indicated by specimens from different parts of the whole region from the Fraser River to the Arctic Sea. A suitable fragment having been discovered, it has evidently been carefully sawn up into pieces of the required shape and size, the sawing having been effected either by means of a thong or a thin piece of wood, in conjunction with sharp sand. This rude method of dividing the stone must have been very laborious, and produced a widely gaping cut before any great depth was obtained. From the fragment of a boulder obtained at Lytton (Fig. 2) flat pieces intended for adzes have been sawn off, the cuts having been carried in from the surface, on each side, till it became possible at length to break the central rib by which the piece to be detached was still united to the main mass. The boulder from Yale (Fig. 1) shows the same process in an earlier stage, though deep cuts have been made on both sides of the stone, one of which is shown in the illustration. Several of the adzes or chisels show that the same method of sawing was adopted to trim off the edges of the flat pieces first obtained, and to render them parallel sided. Pieces thus cut from the edges of adzes are represented among specimens from graves near Lytton. Figure 3 represents a selvage piece of this kind, which has been sawn through on two sides. Figure 4, presents front and side views of a small adze from the same place, the edge still showing the median rib between two opposite saw-cuts, which has not been ground of.

Having been thus roughly blocked out by sawing, the surfaces of the adze were next generally ground flat. In the more finely worked specimens, this subsequent grinding has almost or altogether obliterated the original shaping furrows, and the surfaces have eventually been well polished.



(All the figures one-fourth actual size.)

Description of Figures.

Fig. 1. Partially cut boulder of brownish, opaque jade, found in an excavation at Yale by Mr. T. Eales.

Fig. 2. Portion of a boulder of green, mottled, sub-translucent jade obtained from the Indians at Lytton by Rev. Mr. Good. The figure shows the surfaces of two deep sawn-cuts, with a rough intervening projection where the stone has eventually been broken.

Fig. 2 *b*. Section of the same specimen at right angles to the last, showing depth and gaping character of the saw-cuts.

Fig. 3. Selvage piece, probably cut from the edge of an adze, ground flat on two sides, and sawn from back and front at both edges. Pale green translucent jade from old Indian graves near Lytton.

Fig. 4. Front and edge views of a small adze, showing saw-cuts from front and back nearly meeting, and a narrow intervening broken rib. Jade nearly identical in appearance with the last, and from the same place.

EXTRACTS FROM A PAPER BY PROF. A. B. MEYER, ON NEPHRITE AND ANALOGOUS MINERALS FROM ALASKA.

[Uber Nephrit und ähnliches Material aus Alaska. Jahresbericht (xxi) des Vereins für Erdkunde zu Dresden, 1884.]

"The hypothesis has been contended for, principally by Prof. Heinrich Fischer of Freiburg in Baden, and has even recently maintained, that the rough material for the nephrite and jadeite implements which have been found throughout America, is of Asiatic origin. I opposed that hypothesis in my work, 'Jadite und Nephrit-Objecte,' (1882-83) and in my essay, 'Die Nephritfrage, kein ethnologisches Problem,' (1882-83), taking for my ground general arguments which, however, forced irresistible conclusions upon me, and in particular I had, by induction, become convinced of the presence, in America, of the required rough material.

"Meanwhile, sooner than I could have expected, the discoveries of later travellers have brought to light facts which establish the occurrence of rough nephrite at least, in North-west America; consequently, the theory of importation of *this* material falls to the ground, as far as it refers to importation into America, and it will be the same as to American jadeite. It is also autochthonous. This might, in advance, be confidently asserted; how much more so now that the rough nephrite has been discovered.

"It was, indeed, long a matter of doubt, whether there occurred in America any nephrite implements, or whether all the so-called mineral from that continent was not jadeite. Both Prof. A. Arzruni, of Breslau, (Zeitschrift für Ethnologie, 1883, p. 172), and myself, arrived at the conclusion that there had not yet been produced any positive proof of the occurrence of nephrite in America. Since that date, Prof. Arzruni has been able to declare, with certainty, after microscopic examinations, that an axe from Venezuela was made of a nephrite of typical structure, (Z. f. Eth., Ver., 1883, p. 528): 'It is the one in the Ethnological Museum in Berlin, from the Karsten collection, (1852), V. A. 25, on the catalogue.' Prof. Fischer had already made mention of this specimen in 1875 (N. u. J. p. 47, fig. 62), but could recognize it only as 'approaching a nephritoid composition.'

"I shall, therefore, be all the more justified in describing here two nephrite implements which Messrs. Arthur and Aurel Krause brought from the Thlinkeet Indians in south-east Alaska, and which in the 'Catalogue of the Ethnological Collection from the country of the Chukches and South-east Alaska,' by these two gentlemen (Supplement to part 4, Vol. V, of 'Deutschen Geographischen Blätter,' 1882) is thus described:—

No. 143. Small stone axe, named *tayéss.**

No. 168. Battle-axe of nephrite, with wooden handle, named *kœt-oo'*. The sharpened stone is called *tzoo-ŭta,* the handle, *ă'-shak-tee.*

"The specimens belong to the Bremen Natural History collections and the director, Dr. Spengel, was so good as to trust them to me for examination, after Prof. Arzruni had kindly called my attention to their presence in this museum.

* This is probably Tai-i (Tyee of Gibbs' vocabulary), a Chinook jargon word, meaning 'chief' or 'chief's,' commonly used to denote anything especially valuable or of superior quality.—G. M. D.

"On p. 10, of the catalogue is appended the following remark: 'As to the origin of the stone weapons and utensils, the Thlinkeets can give no other information but that they are very old.' The specimens bear now the numbers 2303 and 2316."

Prof. Meyer then proceeds to describe in detail the two implements above referred to. The colours of the first (No. 2303) are said to be, by Radde's scale, grass-green, yellow-green, and yellow-green-grey; the specific gravity 2·96. The second and larger implement (No. 2316) is grass-green, yellow-green-grey, and green-grey; the specific gravity, 2·92, and the hardness less than usual in nephrite, owing to an incipient decomposition, which is clearly apparent on microscopical examination Under the microscope, the mineral is found to possess a very peculiar netted fibrous structure, which is minutely described by Prof. Arzruni. It is said to resemble closely a nephrite from the Kitoj River in Siberia.

An analysis by Dr. Frenzel of this specimen (No. 2316) shews it to be a nephrite, with large proportions of alumina and water. An analysis of a specimen from Point Barrow, also quoted, clearly resembles the last, but contains less alumina and water.

"As already stated, nephrite axes which were known to come from North America, have been previously believed to have originally been derived from Asia; they were asssumed to be the first stage of the supposed advance of nephrite eastward. Prof. Fischer was not the only one to contend for this view till even quite lately, as seen in particular in the XVth Vol. of 'Archiv. für Anthropologie,' (1884, p. 164); where it is said that a nephrite borer from the Mackenzie River agrees very well with the Siberian nephrite, and that it would therefore be difficult to prove that the rough material is of North American origin, a view which after the above communication is now indefensible. Nordenskiöld has also in his work 'The Voyage of the Vega' broken a lance for the same contention.* In the

* Prof. T. W. Putnam in a communication to the Massachusetts Historical Society in 1868 still maintains the probable Asiatic origin of jadeite objects found in Central America.

2nd vol. (1882), is represented a harpoon-point of bone and nephrite * from Port Clarence (about 65° N. latitude, north of Norton Sound), and he says: † 'Among these (*i. e.* the ethnographical objects obtained in Port Clarence by barter), may be mentioned bone etchings and carvings and several arrow-heads and other tools of a species of nephrite so puzzingly like the well known nephrite from High Asia, that I am disposed to believe that it actually comes originally from that locality. In such a case, the occurence of nephrite at Bering Strait is important, because it cannot be explained in any other way than by supposing that the tribes living here have carried the mineral with them from their oriqinial home in High Asia, or that during the stone age of High Asia, a like extended commercial intercommunication took place between the wild races as now exists, or at least some decades ago existed, along the northern parts of Asia and America.'

"Already in my essay, 'Die Nephritfrage, kein ethnologisches Problem' (March 1883), I expressed the following view: 'Nephrite implements, from the Aleutian Islands, and from the Eskimo on the American side of Bering Strait, may just as well have come from sources in the New World,' and that without trusting ourselves to pass judgment in advance on the matter. In the meanwhile, Mr. Baird's 'rough material' was discovered (Ausland, 1883, p.p. 456, 540, 580), though as we shall see farther on, it was not nephrite, but only a mineral exteriorly very similar to nephrite. Capt. J. A. Jacobsen, however, brought from Alaska, real rough nephrite, which seems to set the question at rest.

"Prof. Arzruni was so good as to place at my disposal, the following statement:—

"'According to kind communications of Capt. Jacobsen, green neprite is known to the Eskimo *in situ*, in the extreme north-west of Alaska. Capt. Jacobsen obtained a number of objects, made of this mineral, and also some

* Page 229, Fig. 3, of English transalation, by A. Leslie, London, 1881.

† Page 236 of English translation.

rough pieces which he thought to be nephrite. Thanks to the courtesy of Mr. Bastian, I was enabled to examine, microscopically, splinters of this mineral. The worked object which furnished me splinters, is a chisel which Capt. Jacobsen obtained on Queen Charlotte Islands. In its microstructure this nephrite does not at all differ from that described above. According to Capt. Jacobsen, there are also objects of this green nephrite all over Vancouver Island and in the Chilkat territory on the continent.

After describing the colours of the objects, Prof. Arzruni continues:—" 'Capt. Jacobsen states that the rough stone is obtained at five days' journey inland. He did not visit the spot himself, though he knows the position of the rocks. The best of the extracted; pieces are chosen for working. Only two Eskimo shamans know the locality, and keep it secret. Of the rough pieces obtained and supposed to be nephrite, two proved to be such, namely, numbers 407 and 409. No. 407 is described by Mr. E. Krause as a rolled pebble or boulder, which, by the whetting of knives, etc., on it, has been superficially ground, but not for the purpose of working it. A slice of this piece presented a microscopic appearance quite analogous to that of the slices from the two nephrite implements previously described. No. 409, on the contrary is, according to Mr. Krause, a small piece of nephrite, altogether untouched for the purpose of working. It agrees in all points with No. 407 It is of a beautiful green, semi-translucent, of a structure somewhat laminated, and with magnetite inclusions. It was found during Capt. Jacobsen's stay at Norton Bay, near St. Michael, at the Kwichpak mouth, about twenty miles north of the Yukon river, and is a rolled pebble. A quite similar structure is seen, according to Mr. Krause, in No. 408 of the collection, a boulder or rolled stone, which has been used in its natural shape as a whetstone, whereby it has been superficially smoothed. In reference to the absence of any other rough specimen, Capt. Jacobsen remarks that nephrite constitutes for these people their most valuable property, which they naturally do not allow to lie unutilised, any more than we ourselves our money, but which they work up immediately they have obtained it from the shamans who quarry it in the mountain. Moreover, whether the pieces be rough, partly or altogether worked, does not affect the question of the actual occurrence of nephrite there in the country, for any one who will not acknowledge the fact of the occurrence, until it has been reported by an European eye-witness. Nobody will, any more than Capt. Jacobsen, doubt the correctness of the reiterated testimony of the natives, considering the large number of nephrite objects which are scattered in the whole district, and especially along the west coast and on the islands.' "

"Henceforth the occurrence of rough nephrite in Alaska must be considered as established, and it is quite certain that it is also worked in the country itself. The nephrite comes neither in a rough nor in a wrought state from Asia; such a view cannot be any longer entertained. Capt. Jacobsen remarks also as against such hypotheses, that if Siberia were the place of origin, there would surely be found in the Chukches country larger quantities of rough and of worked specimens for transportation, but they are there scarcely known.

"In reference to the described nephrite chisel from Queen Charlotte Island, Mr. Arthur Krause called attention to the following passage in Dawson's report,—Geological Survey of Canada, 1878-79, p. 146 B—where, on the subject of the stone implements in the island, it is said:— 'The material of these tools appears to be a matter of indifference, as I have seen them made of hard, altered igneous rocks, like those so common in the country, of a hard, sandy argillite and of the peculiar greenish jade, which the natives of some other parts of the province prize so highly. This latter mineral is not, according to the Haida, found in the islands, but has occasionally been obtained in the course of trade.'

"After the discovery of rough nephrite in Alaska, there is no need of referring to Asia to account for the nephrite implements of North America, nor indeed any part of America, which besides, on general considerations, would never have been necessary.

"Mr. Arthur Krause further called the attention of Prof. Arzruni, to another passage on a rough mineral in North America,—respecting which, it indeed remains to ascertain whether the mineral is really nephrite. In Sir John Richardson's work, published in 1851, 'Arctic searching Expedition,' we read (Vol. I., p. 312): 'At a cascade in Rae River, ten miles above its mouth, walls from eight to twenty feet high, of bluish-grey quartz-rock, in thin layers, hem in the stream. . . . . At this place, Mr. Rae discovered (1849) among the limestone and quartz-rock, layers of asparagus-stone or apatite, thin beds of soap-stone and some nephrite—or jade—a group of minerals which belong to primitive formations.' The Rae River empties into Coronation Gulf, about 115° W. longitude, and 67½° N. latitude, and the Mackenzie River, the nephrite borer from which Prof. Fischer would not acknowledge to be of American origin (see above), flows half-way between the gulf just named and Cape Barrow.

"Mr. Virchow has lately (Zeitschrift für Ethnologie, 1883, p. 482) endeavoured to contest the belief as to the occurrence of nephrite in Alaska as follows: 'Nothing could be more natural than that even Mexico and Central America should have been provided from the northwest coast, and there would be nothing surprising if, after the nephrite question has been seemingly altogether set at rest for America, the old way of the Toltecs were again suddenly proved to be the commercial path of nephrite.' Herewith the transportation hypothesis which has fortunately been set aside as to commercial intercourse from continent to continent, is again taken up by Mr. Virchow, in reference to inter-regional trading in America, a view against which I not only entertain the gravest doubts, but hold to be undefensible, *for it will be found there are in* America quite as many different localities yielding nephrite (and jadeite) as have already been recognized for Asia and for Europe. I propose shortly to develop the last point. A number of well known general considerations are opposed to Vichrow's contention, especially the fact that the Alaska nephrite is of a type different from those of Venezula and

Brazil. Axes from both these countries have been mentioned by Prof. Arzruni (Zeitschrift für Ethnologie, 1883, p. 482), who has since informed me that the Brazilian axe represents a type of nephrite so far unknown, from which that of the Venezuela axe again differs."

The latter part of Prof. Meyer's paper relates to a white or grey mineral which has been referred to as 'jade,' but which proves to be pectolite. His remarks on this subject may be summarized as follows:—

The rough mineral from Alaska reported on by Mr. Baird, and previously alluded to, proved to be neither nephrite nor jadeite, but pectolite. Specimens altogether unworked, were not found, but so many that were only partly worked that there can be no doubt of their local origin. Small pieces of a rolled boulder, which had been used as a hammer for breaking bones, and which was obtained at Point Barrow, behave chemically in just the same way as pectolite from Bergenhill, New Jersey. Both were decomposed by acids, after heating to redness and gelatinised. The composition approaches the formula $(Ca, Na_2, H_2) Si O_3$.

Capt. Jacobson also collected many implements of the same mineral in the region between Kotzebue Sound and Cape Barrow, and also in the tundra, between the rivers Kosksquim and Yukon. Most are cylindrical hammers, some as long as 20 cm. with a diameter of 8 cm.

Colour sometimes turning to neutral gray in spots that are also much less translucent. Hardness near that of quartz (7), greater than usual in pectolite (4–5). Also abnormal in not being dissolved in acids with separation of silica of jelly-like consistence; but in these two peculiarities, agreeing with pectolite from Knockdolian, Scotland. Optical qualities and cleavage normal.

The mineral is said, by the natives from Kotzebue Sound to Cape Barrow, to be obtained in the mountain chain which extends along that coast; one particular locality being the side of a mountain about twenty-five miles from Nulato, on the Yukon, another on one of the streams flowing into Kotzebue Sound, where a vein, or perhaps dyke, extends from the water up to the crest of the hill. The Innuits of Koviak Peninsula, near Bering Strait, make many tools of the same stone obtained from mountains in the immediate neighbourhood.

In southern Alaska, from Norton Sound to near Bristol Bay, the mineral is altogether, or nearly altogether, unknown to the natives. On Bristol Bay, however, fine pieces obtained by Mr. McKay, indicate another locality in that district.

On the Siberian shore of Bering Straits, fragments are rare, and were said to come from the American side.

CANADIAN ORTHOPTERA.

BY F. B. CAULFIELD.

To the order Orthoptera belong the insects known to us as Crickets, Grasshoppers, Locusts, Walking-sticks or Spectres, Cockroaches, and Earwigs. These insects are active during all their stages, the principal difference between the larva and adult insect being that of size, and in the greater number of species, the presence of wings. They are voracious eaters, and have the mouth parts highly developed, the mandibles being fitted for both cutting and grinding.

Under favourable conditions, such as a succession of hot and dry seasons, some species of locusts, (*Acrididœ*) multiplying to an almost inconceivable extent. Leaving their breeding grounds in vast swarms, and swept along by favouring winds, they at times travel to great distances, and wherever they alight, devour every green thing.

In general, however, orthopterous insects are timid insects and of feeble powers of flight. In fact, many species can only sustain their flight for a few yards, while some are entirely wingless.

If we examine an orthopterous insect, we will find it to be an apparently helpless creature, its mandibles not being sufficiently powerful to inflict a wound, and its means of defence, when captured, being limited to the discharge of a dark colored fluid from the mouth. A few kinds conceal themselves in holes and crevices, but the greater number live in the open fields, delighting to bask in the summer sunshine.

It is evident then that these creatures, being as a general rule possessed of limited powers of flight, and being unable to defend themselves, would, unless they could by some means escape observation, be entirely at the mercy of their enemies.

The facility of eluding observation which is common to many insects, and which attains great perfection in the orthoptera, is owing to the similarity of their colors to the surroundings amidst which they live, and is enhanced by the habit, which many species possess, of remaining motionless when danger appears to threaten them.

When walking through the fields during the summer months, we hear the songs of the orthoptera on every side, but we seldom see the insects themselves, until alarmed by our approach, they spring almost from beneath our feet. And how quickly we lose sight of them again when they alight, so wonderfully do their colors harmonize with the localities in which they live! A little observation will show us that differently colored species inhabit different localities. Thus, on bare, gravelly places and road-sides, we find the large dull colored locusts that rise with a spring, and hovering for a few seconds with a crackling noise, drop suddenly to the ground, and are as quickly lost to view. In dry fields and pastures, where the herbage is poor, we find species marked with lines and spots of pale yellow, and different shades of grey and brown, these subdued tints just matching the scanty growth, intermixed with the withered stalks of the previous year. In moist places, and upon shrubs and trees, species occur whose color is wholly green, and these are, perhaps, the most difficult of all to detect, their color assimilating so closely with the leaves. Thus, these insects, although seemingly at the mercy of their enemies, are in reality amply protected, and are able, not only to hold their own in the struggle for existence, but under favorable conditions, at times, to multiply to an almost incredible extent.

Another remarkable feature of the orthoptera, is the musical power with which many of them are endowed. They are instrumentalists, not vocalists, as the orthoptera, like all other insects, breathe through spiracles, and are, of course, voiceless. In reality, the song of an orthopterous insect is a sexual call, and is almost entirely confined to the males—entirely so in the crickets, some species of which go through quite an elaborate performance, as may be easily seen by watching the common striped cricket, *Nemobius vittatus.*

When a male of this species wishes to attract the notice of the female, he advances towards her, and raising the wings and wing-covers, rasps them together with a shrill creaking sound, now and again jerking himself forward with a convulsive movement, touching the female with the antenna, at times dancing around in a frantic manner. Should the female be pleased with his attentions, she turns around, and seizing him, draws him beneath her, when copulation takes place. Should his song prove unsuccessful. the little minstrel either stops shrilling, or turns his attention to another female. I have not observed the courtship of our other species, but it is probably much the same in all. Mr. W. H. Harrington, speaking of *Æcanthus niveus,* says, " An interesting feature of its concerts is one of which I have not been able to find any mention in books accessible. While the male is energetically shuffling together its wings, raised almost vertically, the female may be seen standing just behind it, and with her head applied to the base of the wings, evidently eager to get the full benefit of every note produced."

The courtship of *Ectobia germanica,* is very similar, but is unaccompanied by any sound, nor are the wings shuffled together. The male follows the female until her attention is attracted, when turning around, and raising the wings until they form a right angle with the body, backs up to, and seized by the female. I have only seen actual copulation take place in *Nemobius,* but have little doubt that in both *Blatidæ* and *Gryllidæ,* the male never takes possession of the female by force.

In preparing this sketch of our Canadian species, I have followed Mr. Scudder's classification, as given in Packard's "Guide." With regard to localities, dates of appearance, &c., unless otherwise stated, it is to be understood that they refer to the neighbourhood of Montreal.

Fam. 1. GRYLLIDÆE Latreille, CRICKETS.

The Crickets have a rather large head and thorax. The antennæ long and filli-form (thread-like.) The wings are laid flat on the body, the costal edge of the front pair being bent down so as to slightly overlap the body. The hindmost thighs are very stout and muscular, enabling them to make enormous leaps. The ovipositor is long and spear shaped. Packard says that "The *shrilling* of the male is a sexual call, made by raising the fore wings and rubbing them on the hind wings. The noise is due to the peculiar structure of the fore wings, the middle portion of which forms, by its transparent elastic surface, on which there are but few veinlets, a resonant drum, increasing the volume of sound emitted by the rubbing of the *file* on the upper surface of the hind pair of wings. This file is the modified internal vein, the surface of which is greatly thickened, rounded and covered closely with fine teeth. In the females, the wings are not thus modified, and they are silent."

The mole-crickets (*Gryllotalpa*) may be recognized by their powerful fore feet, which somewhat resemble those of a mole, being short, stout and flattened, and armed with tooth-like projections. They inhabit moist and soft earth, in which they drive burrows or tunnels in search of food. According to Packard, their eggs, from 300 to 400 in number, are laid in the spring in tough sacks in galleries.

Only one species—*Gryllotalpa borealis*, Burm—is recorded from Canada, where it appears to be very rare. Mr. William Brodie has taken a pair in Essex county, Ont. It probably does not occur in the Province of Quebec, as it is not given in the Abbé Provencher's list, nor have I met with it myself.

The large black crickets, so common in dry fields during the summer months, belong to the genus Gryllus. They are great lovers of heat, their favourite localities being sunny hillsides, where they live in holes and crevices in the soil, or beneath stones or clods of earth.

Harris in his "Insects Injurious to Vegetation," says:— "Where crickets abound, they do great injury to vegetation, eating the most tender parts of plants, and even devouring roots and fruits, whenever they can get at them. Melons, squashes, and even potatoes, are often eaten by them, and the quantity of grass that they destroy must be great, from the immense numbers of these insects which are sometimes seen in our meadows and fields."

Our largest species is *Gryllus luctuosus*, Serv. It may be easily distinguished from our other species "by the great length of the wings, which, surpassing in length the wing-covers, hang over the extremity of the abdomen." (Scudder.) It seems to be very rare in Canada; I found two females in August, on Montreal mountain, some years since. It is recorded from Nova Scotia by Walker.

Gryllus Neglectus, Scudder, is our commonest species. Specimens of it in the larval condition may be found under stones as soon as the snow has melted in spring, and towards the end of May many of them have attained the perfect condition and may be heard shrilling; but some individuals are later, as I have taken an adult female and a specimen in the pupa state beneath the same stone on June 4th, 1885.

I have not been able to ascertain whether these hybernated specimens live until the end of the season or deposit eggs during early summer and then die, but so far as I have observed, their shrilling entirely ceases during July. In the beginning of August a few may be heard, and by the middle of the month they are again in full chorus, appearing to be more numerous than in the earlier part of the season. Packard says that they have been known to lay 300 eggs, glued together in a common mass. I have examined freshly laid clusters but did not observe that they were glued together, but the moisture with which they are coated may act as a cement when dry.

Province of Quebec, very common.—Provancher. Montreal, abundant.—Caulfield. Toronto, very abundant.—Brodie.

Besides our native species of *Gryllus*, we have the well-known House-cricket, *Gryllus domesticus*, Oliv., which has been carried over in shipping from Europe. This creature loves warm quarters, being found in kitchens and bake-houses, where it feeds on crumbs and other scraps, not being particular as regards diet. During the day it hides in chinks and crevices, coming out at night in search of food. During the summer it sometimes takes up temporary quarters in the open air.

Quebec, common.—Provancher. Montreal, common.—Caulfield. Toronto, rare.—Brodie.

The small black crickets that swarm in our meadows belong to the genus *Nemobius*. They may be distinguished from the species of *Gryllus* by the last joint of the palpi being twice the length of the preceding joint, by their smaller size, and by the thorax being slightly hairy.

(*To be continued.*)

Height of Clouds.

By C. H. McLeod.

The table given below contains the results of some observations on the height of clouds during the months of May and June, 1886. The observers were J W. McOuat, B.A., and Francis Topp, B.A. The method of work consisted in simultaneous observations of altitude and azimuth. The stations—McGill College Observatory (A) and the roof of the City Hall (B)—gave a base of 6,300 feet. Communication between the observers was by the telephone. The observations were reduced graphically, and as each set of measurements gave two independent results, a gauge of accuracy was obtained and wrong results from errors in identification avoided. The precision with which such measurement may be made, depends mainly on the possibility of minutely describing the portion of cloud on which it is esired to make the pointing. Otherwise the lines of collimation of the instruments may not meet, and the results will be discordant.

The heights due to the angles of altitude at both stations are given in colums 3 and 4, and the mean of these quantities in the last column.

The small altitudes obtained for the cirrus clouds is especially worthy of notice.

Date.	Class.	Altitude in feet.		
		Station (A)	Station (B)	Average.
May, 17	Cumulus	1,160	1,065	1,112
" 19	"	1,240	1,460	1,350
June, 3	"	7,400	8,460	7,930
" 3	"	7,800	7,280	7,540
May, 19	Cumulo-Stratus ..	9,960	11.000	10,480
June, 3	" ..	6,460	6,400	6,430
June, 9	" ..	5,260	4,620	4,940
May, 18	Cirro-Cumulus ...	2,280	1,340	1,810
June, 9	Cirro-Stratus.....	11,600	9,560	10,580
May, 19	Cirrus	12,760	13,800	13,280
June, 10	"	12,080	9,620	10,850
" "	"	16,180	16,960	16,570
" "	"	13,620	17,500	14,560
" "	"	18,760	19,320	19,040
" "	"	18,400	16,060	17,230

McGill College Observatory,
December 15th, 1886.

Proceedings of the Natural History Society.

The first meeting of the session was held on Monday evening, November 29th, 1886, Sir J. Wm. Dawson in the chair.

The minutes of the last annual meeting were read and approved, and the minutes of the last Council meeting were also submitted to the meeting.

The Honorary Curator announced the following donations, viz.:—A young Harp Seal, from Rev. D. V. Lucas, and a Nest and Eggs of the American Robin, from Dr. Wanlass.

The Chairman of the Library Committee reported the receipt, from Sir Wm. Dawson, of a copy of the "President's Address, British Association, 1886," and a number of Periodicals and Journals from J. A. U. Beaudry, Esq.

Members proposed were R. R. Grindley, Esq., and A. F. Gault, Esq., and the following were duly elected ordinary members, viz.:—Messrs. James Slessor, Samuel Waddell, and Rev. John Nicholl. Master Bertie Nicholl was also elected a junior member of the Society.

The Honorary Curator, Alfred Henry Mason, F.R.M.S., F.C.S., called the attention of the Society to the lack of interest in the work of the "Ornithologists' Society" in our city, as the wearing of the wings of birds for decorative purposes was not by any means diminishing.

On motion of Mr. Mason, seconded by Major Latour, it was resolved to open the Museum free of charge to visitors during the Carnival week of 1887.

The action of Chairman of Council in granting the use of the Hall and Museum to the Victoria Rifles for Saturday, December 4th, was unanimously approved.

The question of adopting measures for holding a "Conversazione" during the session was referred to members of Council.

Sir William Dawson then reviewed some of the papers read before the Geological Section C of the British Association at Birmingham, and exhibited photographs of a portion of the subjects under consideration.

On motion of Dr. Edwards, the acting Chairman, a cordial vote of thanks was passed for the instructive address.

Mr. G. F. Matthew's paper was held over for additional notes on "New Pteraspedian Fish," and the respective papers on "Tendrils in the Virginia Creeper," by A. T. Drummond, and "Notes on the Tendrils of Cucurbitaceæ," by Prof. Penhallow, having been read, proved of special interest, and brought on a salutary discussion, in which several of the members engaged.

A vote of thanks was passed for each of the papers kindly prepared by Mr. Drummond and Prof. Penhallow.

The second monthly meeting took place on Monday evening, December 27th, 1886, Dr. T. Sterry Hunt, First Vice-President, in the chair.

Minutes of the previous meeting were read and confirmed, and the minutes of the last Council meeting were also read.

An important donation of books from the Smithsonian Institution was announced by Mr. Beaudry, Chairman of the Library Committee, and a detailed list of the different works was submitted by Mr. Robb, with an interim report on the condition of affairs in connection with the binding, classifying and cataloguing of the books in the Library.

On motion of Mr. Beaudry, seconded by Mr. Stevenson Brown, a vote of thanks was passed to the several donors referred to in the report; and on the recommendation of Mr. Robb, it was resolved that a special letter of thanks, signed by the President and officers, be transmitted to the Smithsonian Institute, through Spencer F. Baird, Esq., Secretary, who had kindly interested himself in the gift of so many valuable publications, numbering in all, over fifty volumes.

Mr. Mason presented a specimen of "Stropanthus Hispidus," which has attracted considerable attention amongst the medical profession in England as a cardiac stimulant.

The members proposed were Messrs J. W. Buckle, W. H. Chapman, and Dr. J. Lapthorne Smith, and Messrs. R. R. Grindley and A. F. Gault were elected ordinary members.

Dr. Harrington announced that an energetic committee had been formed, and that arrangements for the "Conversazione" were progressing most encouragingly. Mr. Stevenson Brown, the Secretary, presented a complete report of the proposed programme in connection therewith, the date having been fixed for Thursday, January 20th.

Dr. G. M. Dawson being present, gave a most interesting synopsis of his written paper on the Canadian Rocky Mountains, and in reply to a question by the Chairman, made a general statement on their geological formation, and in reply to an enquiry from Professor Mills, referred briefly to insect and bird life on the Rockies.

In the absence of Professor Penhallow, the second paper of the evening, on "The Occurence of Scolithus in Beds

Newer than the Potsdam," by Henri M. Ami, M.A., was held over for another meeting.

The Chairman of Council, John S. Shearer, Esq., reported the receipt of a remittance of $400.00 from the Quebec Government, in place of $600.00, the amount allotted during last session towards the cost of publishing the "Record of Science."

A cordial vote of thanks having been passed to Dr. G. M. Dawson, the meeting adjourned.

The third monthly meeting of the sessiou was held this (Monday) evening, January 31st, 1887, at eight o'clock, at which there was a good attendance.

Sir William Dawson in the chair.

Minutes of the previous meeting, and that of the last Council meeting, were read and approved.

Mr. J. Stevenson Brown presented a final report of the duties performed by the "Conversazione Committee," and on motion of Mr. Brown, seconded by Rev. Robt. Campbell a unanimous vote of thanks was passed to the numerous friends who had so kindly aided in bringing the entertainment to a most satisfactory conclusion, and the Recording Secretary was instructed to convey a copy of the resolution to each of the friends who had in any way assisted at the "Conversazione."

On motion of W. T. Costigan, seconded by Prof. Mills, a well merited vote of thanks was passed to the members of the "Conversazione Committee" for the exceptional manner in which they had carried out the work.

Members proposed at the last meeting, Messrs. J. W. Buckle, W. H. Chapman, and Dr. Lapthorn Smith, were duly elected.

Dr. Edwards recommended that the rules be suspended, and no objection being offered, the following gentlemen were proposed and elected by ballot, viz.: F. W. Blaiklock, Jas. A. Carnegie, F. W. Barnes, M.D., J. L. Lamplough, H. W. Thomas, T. A. Rodgers, M.D., T. L. Wanklyn, and Robert Harvie.

A letter was read from C. S. Minot, Esq., of Boston, intimating that a formal application was necessary to obtain the $200.00 granted by the "Elizabeth Thompson Science Fund Trustees," and it was resolved that Prof. Penhallow and the Chairman of Council, Mr. Shearer, be appointed a committee to take action thereon, and associate with them Prof. C. H. McLeod, of McGill University, in the work of investigating "underground temperatures."

Prof. Donald then read a valuable paper entitled, "Chemical Notes on Wheat and Flour," and the opinion was expressed that this important paper should be followed by others bearing on the further examination of the subject. Prof. Donald answered several questions submitted to him, and displayed a variety of samples of wheat and flour.

Prof. Mills followed with an interesting account of a visit to the Bahamas, describing "Life on the Islands," and gave a general outline, accompanied by diagrams on the blackboard, of the formation of coral reefs. At the close of the address, Mr. J. Stevenson Brown moved, seconded by Mr. Beaudry, that a vote of thanks be passed to both Prof. Donald and Prof. Mills for their respective papers.

Prof. Mills kindly promised to return to the subject *again, and presented the Society with a number of* specimens exhibited during the course of his address, for which the President expressed the thanks of the Society.

A committee was named by the President, consisting of John S. Shearer, Prof. Penhallow, J. A. U. Beaudry and the Recording Secretary, to prepare and present to the members of the Quebec Government a petition for the renewal of the original grant of $1000 per annum, to be used exclusively in the publication of the RECORD OF SCIENCE.

Dr. Harrington, Chairman of the Lecture Committee, reported the following subjects for the Course of Somerville Lectures, 1887:—Thursday, February 17th, "The Bony System," by Francis J. Shepherd, M.D.; Thursday, February 24th, "The Muscular System," by George E. Armstrong, M.D.; Thursday, March 3rd, "The Nervous System," by James Stewart, M.D.; Thursday, March 10th, "The Circulatory System," by T. Wesley Mills, M.A., M.D.; Thursday, March 17th, "The Special Senses," by Frank

Buller, M.D.; Thursday, March 24th, "The Digestive System," by W. H. Hingston, M.D., D.C.L.

The regular monthly meeting took place on Monday evening, February 28th, 1887, Sir Wm. Dawson occupying the chair.

Minutes of previous meeting were read and approved, and the minutes of meeting of Council were also read.

Mr. Ernest Ingersoll was proposed for membership.

The Committee appointed to confer with the Local Government in regard to the annual grant, reported progress.

Mr. F. Bain's paper on "A Permian Moraine in Prince Edward Island" was read by Sir Wm. Dawson, and Mr. F. B. Caulfield followed with an extended account of "Canadian Orthoptera."

A vote of thanks having been passed to the author of each paper, the meeting adjourned.

MISCELLANEOUS.

BACTERIA IN DRINKING WATER.—Mr. Meade Bolton has contributed an important paper on this subject to Koch and Pflüger's *Zeitschrift für Hygiene*. He finds that in ordinary spring water, bacteria are always present and are capable of multiplying in it. Among these may be specially mentioned *Micrococcus aquatilis*, occurring as cocci collected into small irregular heaps, and *Bacillus erythrosporus*, distinguished by its spores having a reddish brown sheen, and the presence of a greenish pigment without any deliquescence of the gelatine in which it was cultivated. Both these bacteria multiply with extraordinary rapidity in water, the quality of the water and the amount of organic and inorganic substances contained in it appearing to have no effect on the reproduction of the microbe, which is, however, materially promoted by a rise of temperature. It took place considerably quicker at 35° than at 20°. These bacteria are not pathogenic.

On the other hand, the author found that pathogenic bacteria, when introduced into spring water, never multiply, but disappear after a time varying in lengh according to the species and the temperature, and according as to whether the species produces resting spores or not. The spores of Bacillus antheracis had not lost their vitality in a year and a day; those of typhus fever were still active after a month but not after ten and a half months. The quality of the water appears to have no influence in prolonging the life of pathogenic bacteria.

The general conclusions drawn by the author are that the quantity of bacteria present in spring water is *no guide whatever* in determining the wholesomeness or otherwise of the water for drinking purposes, since they are most entirely harmless, and that it is impossible by chemical analysis to determine the presence of bacteria in larger or smaller numbers. The presence of specific pathogenic bacteria can only be determined by direct nicro-chemical observation.

HOW MYRIAPODS ARE AFFECTED BY LIGHT.—F. Plateau has recently investigated the extent to which Myriapods, both those that are blind and those possessed of eyes, can distinguish a lighted from a shaded spot. He resorted to various contrivances to graduate the quantity of light and shade, and to have the one sharply marked off from the other. It was also necessary to provide against the danger of fallacy from the influence of heat rays—which was accomplished by placing in the path of the incident rays a flat-sided glass vessel, containing water which absorbed the heat, but allowed the light to pass. After many experiments, he draws the following conclusions:

1. Myriapods which are blind, perceive the light of day and know how to discriminate between light and darkness.

2. In both those with and those without eyes, a certain time must elapse before they can perceive whether they are in shadow or in light.

3. The duration of this latent period is not longer in the blind than in those with eyes.

1. When a shaded area is relatively small to the lighted one, they do not practically distinguish between the two.

5. Myriapods like moisture, and this explains also why they seek shady places, habitually.

These conclusions are interesting, inasmuch as they show that animals may be affected by light apart from those sensations which are visual strictly so called, and that such changes as light thus produces so influence the nervous system that the animal gets information of a valuable kind as regards its life interests. Such experiments as these enable one to understand in some measure, perhaps, that beginning of vision which exists in creatures possessing only pigmental spots, as eyes, the pigment in some way retaining the light while it works changes, probably chemical, in the protoplasm.

DIGESTIVE FERMENTS IN PLANTS AND ANIMALS.—It is very interesting to the physiologist to note how many processes, once thought to be characteristic of animals, are being shown to be common to plants and animals alike. The researches of Heidenhain and Langley had demonstrated the stages in the cells of digestive glands by which from the clear protoplasm the formation of the actual digestive ferment as a regular series of constructive and destructive processes, takes place. Recently, J. R. Green has shown that in the germinating seeds of plants, there is a ferment similar to the *proteolytic* ferment of the pancreas; it exists in resting seeds in the form of a zymogen or mother-ferment, but in the germination of seed, it becomes an active ferment.

The reserve proteid of the seed is converted probably into peptone, but the nitrogen is carried to the growing points of the young embryo as a crystalline amide, e. g. leucin, asparagin, etc.

Now, it is well known that the pancreatic ferment differs from the gastric in its power to carry the digestion of proteids on to the stage of formation of crystalline nitrogeneous bodies. (Proc. of Roy. Soc.)

Catalogue of Canadian Plants.—This important addition to Canadian Botany is issued by the Geological Society, and has been completed so far as to embrace I. Polypetalæ; II. Gamopetalæ; III. Apetalæ. This is the most important of the publications relating wholly to Canadian Botany since the appearance of Hooker's Flora Boreali Americana in 1840, and it supplies to the student a wealth of information which has long been a serious want.

From his extensive travels through a large part of the Dominion, and his intimate acquaintance with the flora from personal observation, Prof. Macoun has been able to "speak with accuracy and decision in many points which a more limited knowledge of distribution would preclude." But, as he says, "the present work is by no means final," and the co-operation of botanists in making known those species, which for any reason may have been overlooked, or in more exactly defining doubtful limits of distribution, would be a real service to Canadian Botany. The appearance of this catalogue gives promise that a complete Flora of Canada may be forthcoming before many years, the obstacles to the preparation of which have hitherto been many, but are now chiefly removed.

Isaac Lea, LL.D., the well-known publisher and naturalist, died, at Philadelphia, Dec. 8th, 1886, at the age of ninety-five years. He was born at Wilmington, Delaware, in 1792. From 1858 to 1863, he was president of the Academy of Natural Sciences, and in 1860, president of the American Association for the Advancement of Science. Dr. Lea's scientific work chiefly related to fresh water and land shells. He began a complete work on the *Unionidæ* of the United States, and prepared to expend much time and money in its elaboration, but a fire destroyed all his valuable plates and caused a termination of the work.

The Amount of Caffeine in Various Kinds of Coffee.—From the following quotations it will be seen that great discrepancies exist in the published statements as to the amount of caffeine in raw coffee:—

Robiquet	0.32 to 0.64 per cent.
Liebig	0.23 to 0.46 "
Zenneck	0.75 "
Graham, Stenhouse & Campbell	0.86 to 1.00 "
Dragendorf	0.99 to 1.22 "
Squibb	1.00 to 1.03 "
Bell	1.08 to 1.11 "
Allen	0.50 to 2.00 "

The discrepancy between the data given as applying to roasted coffee is still greater, and in the *Allgemeiner Kaffee Zeitung* for 1884, the amount of caffeine in roasted coffee is stated to range from 2.00 to 3.64 per cent. The first striking result obtained by Dr. Paul and Mr. Cownley on carrying out a number of experiments with several different samples of raw beans, was the very narrow range within which the amount of caffeine appeared to vary. Instead of being a varying amount, it was more nearly a constant quantity, as follows:—

Coorg	1.10 per cent.
Guatemala	1.18 "
Travancore	1.16 "
Liberian	1.20 "
Liberian	1.28 "

The above determinations were all made with undried, raw coffee, taken just as it came to hand and powdered. A difference in the amount of water might therefore alter, to some extent, the percentage of caffeine in the dry material, and a new set of determinations were made, with 14 different berries, all carefully dried at 212°, when the amount obtained varied from 1.20 per cent. in Coorg to 1.39 in Liberian; average for the 14 samples 1.26 per cent. It is evident from these results that the discordant statements hitherto published in reference to the amount of caffeine in coffee must be ascribed to defective methods of analysis, and that, in reality, the determination of the amount of caffeine in a sample of coffee would be one of the most conclusive data to rely upon in any question of adulteration, as, in experimenting with roasted coffee, a similar uniformity was found.

Dr. Paul stated that there was no loss of caffeine in roasting coffee. Roasters had stated that there was a considerable percentage of loss, and, if printed authority was to be taken, the loss was 18 per cent. In his experiments he had failed to detect any loss.

PH. S. J.

METEOROLOGICAL ABSTRACT FOR THE YEAR 1886.

Observations made at McGill College Observatory, Montreal, Canada. — Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s.55$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. Mean.	Thermometer. ¶ Deviation from 12 year means.	Thermometer. Max.	Thermometer. Min.	Thermometer. Mean daily range.	* Barometer. Mean.	* Barometer. Max.	* Barometer. Min.	* Barometer. Mean daily range.	Mean pressure of vapour. †	Mean relative humidity. ‡	Mean dew point.	Wind. Resultant direction.	Wind. Mean velocity in miles per hour.	Sky clouded per cent.	Bright sunshine per cent.	Inches of rain.	Number of days on which rain fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and snow melted.	No. of days on which rain and snow fell.	No. of days on which rain or snow fell.	Month.
January	12.18	+ 0.34	46.8	— 23.6	15.5	30.0685	30.780	28.901	.355	.0797	84.1	8.1	N. 74° W.	12.35	68.7	29.2	1.95	4	17.4	19	3.54	1	22	January ....
February	12.22	— 3.74	44.1	— 21.0	18.0	30.0350	30.638	29.187	.364	.0788	81.0	7.3	S. 69° W.	13.47	62 1	31.3	0.70	6	10.3	17	1.77	3	20	February.........
March	23.15	— 0.51	53.0	— 15.3	13.1	29.9 18	30.539	29.299	.207	.1055	76.5	16.6	S. 80° W.	13.81	70.7	39.0	0.80	5	26.5	13	3.48	2	16	March ....
April	44.24	+ 4.40	74.6	15.8	17.9	30.0794	30.621	29.396	.171	.2055	68.0	33.5	N. 82° W.	10.74	53.2	[illegible]9.9	0.47	9	2.8	4	0.76	0	13	April....... .....
May	54.58	+ 0.40	74.2	37.3	18.5	29.8514	30.242	29.461	.133	.2953	69.7	44.0	S. 67° W.	11.25	66.1	52.6	2.72	18	0.0	0	2.72	0	18	May ....
June............	63.28	— 1.04	80.1	48.3	16.2	29.8846	30.216	29.296	.170	.4208	72.2	53.5	S. 46° W.	9.13	63.4	45.7	2.92	15	0.0	0	2.92	0	15	June.............
July	67.75	— 1.08	87.3	48.4	16.7	29.8740	30.162	29.602	.115	.4977	73.2	58.2	S. 51° W.	13.80	53.1	55.9	3.71	13	0.0	0	3.71	0	13	July.............
August	66.67	— 0.95	86.3	48.6	17.7	29. 043	30.297	29.533	.148	.4780	73.1	57.2	S. 83° W.	14.70	56.4	61.4	4.79	16	0.0	0	4.79	0	16	August.... .....
September	57.33	— 1.55	82.7	34.5	15.9	30.0690	30.469	29.622	.187	.3678	75.9	49.3	S. 60° W.	14.95	46.8	55.5	3.85	14	0.0	0	3.85	0	14	September.......
October	46.65	+ 0.64	72.7	24.5	16.5	30.1 42	30 586	24.415	.243	.2517	75 7	39.0	S. 60° W.	16.43	51.5	55.8	1.79	10	0.5	2	1.84	2	10	October..........
November	33.42	+ 0.63	63.3	11.5	11.7	29.9183	30.457	29.007	.310	.1590	78 9	27.3	S. 65° W.	20.47	71.5	25.8	2.22	9	36.1	18	5.82	5	22	November ....
December	14.21	— 4.32	41.0	— 20.7	14.7	30.0646	30.713	29.176	.310	.0818	81.6	9.4	S. 65° W.	16.32	65.6	32.6	0.96	3	22.4	17	3.05	3	17	December. ......
Means for 1886 ..	41.31	— 0.49	....	....	16 0	29.9804	....	....	.226	.2518	75 8	33.6	....	13.95	60.8	45.4	....	....	....	....	....	..	...	Means for 1886...
Sums for 1886 ...	...	...	....	....	....	...	....	....	....	....	.	....	....	....	....	....	26.88	122	116.0	90	38 25	16	196	Sums for 1886 ...
Means for 12 years ending Dec. 31, 1886.	41.80	....	...	....	...	29.9734	....	....	....	.2510	74.4	....	....	....	60.9	§ 46.5	27.36	133	121.6	85	39.45	16	202	Means for 12 years ending Dec. 31, 1886.

* Barometer readings reduced to 32° Fah., and to sea level. † Inches of mercury. ‡ Saturation 100. § For 5 years only. ¶ ' +" indicates that the temperature has been *higher;* "—" that it has been *lower* than the average for 12 years, inclusive of 1886. The monthly means are derived from readings taken every 4th hour, beginning with 3h. 0m, Eastern Standard time. The anemometer and wind vane are on the summit of Mount Royal. To obtain better exposure, their position was changed on June 30th. The new position is 29 feet N. E. of the old one; 57 feet above the ground and 810 feet above sea level. The old position was 30 feet above the ground, and since August, 1882, it has been somewhat sheltered from N. E. winds.

The greatest heat was 87.3 on July 5th; greatest cold 23.6 below zero on Jan. 12th; extreme range of temperature was therefore 110.9. Greatest range of the thermometer in one day was 43.8 on Jan. 25th; least range was 3.4 on Nov. 13th. The warmest day was July 5th, mean temperature 77 0. The coldest day was Jan. 12th, mean temperature 17.6 below zero. The highest barometer reading was 30.780 on Jan. 14th, the lowest 28.901 on Jan. 9th, giving a range of 1.879 for the month and year. The lowest relative humidity was 25, on May 1st. The greatest mileage of wind recorded in one hour was 54 on Dec. 25th, and the greatest velocity in gusts was at the rate of 80 m. p. h. on Nov. 18th. The total mileage of wind during the first six months of the year was 51,233, which is equal to an average hourly velocity of 11.8 m; and during the last six months 71,032, equal to an average hourly velocity of 16.1m. The average hourly velocity during the past 10 years, in the first half of the year, was 11.85, and in the last half 9.95. The increase in the wind's velocity, due to the change in exposure, noted above, is — on the supposition that the average wind for the past six months has been normal — therefore 62 per cent. The resultant direction of the wind for the year — for mileage — is S. 68° W., and the resultant mileage 56,300. Auroras were observed on 42 nights. Fogs on 19 days. Hoarfrost on 8 days. Thunder storms on 15 days and lightning without thunder on one day. Lunar halos on 15 nights. Lunar coronas on 4 nights. Solar halos on 2 days and Solar parhelia on 2 days. The sleighing of the winter closed on April 8th. The first appreciable snowfall of the autumn was on Oct. 17th. The first sleighing of the winter was on Nov. 7th.